FY2009 Specialty Crop

Block Grant Program – Farm Bill

Idaho State Department of Agriculture

Prepared by: **Amanda Gibson,** Specialty Crop Block Grant Program Administrator

AMS Agreement: 12-25-B-0920

Final Performance Report

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Table of Contents

*Reports from these subrecipients were final in the Second Annual Performance Report for AMS Agreement 12-25-B-0920

Value-Added Solutions for Post Harvest Perishables

Subrecipient
Caldwell/Canyon County Economic Development Council

Project Summary
The project involved the purchase of two key equipment pieces, a fruit press and bin dryer, to enhance the capacity of the UI Food Technology Center. The UI FTC was launched in 2002 with the help of a Specialty Crop Grant. Since then the UIFTC's shared-use model has given users affordable access to processing by utilizing a sliding-fee scale with no minimum usage requirements, a system favorable to small businesses. FTC clients now have a strong presence in local food channels including the farmers' market network. The 2009 equipment grant broadened the center's ability to serve small acreage growers. Many had requested additional options to assist with post-harvest perishables. The addition of a fruit press and bin dryer has given processors shared- use access to versatile tools well suited for a wide array of local fruits ranging from apples to wine and table grapes.

Project Approach
The project was part of a broader initiative to develop the entire UI Caldwell Complex into a center for value-added agriculture. To this end the Caldwell Economic Development Council helped the university secure funding to convert 9,000 square feet of its incubator into climate controlled production and storage space for local wineries. $30,000 of these funds served as the match for the Specialty Crop Grant.

In anticipation of the new grant-funded equipment, the UI Caldwell Complex expanded its outreach to specialty crop growers across the state beginning in 2009. This initiative involved participation in ISDA's annual farmers market meetings, direct marketing to Idaho Preferred members and an active role in the development of the Sunnyslope Food & Wine Trail. In addition, the UI helped host and launch the TVCC viticulture and enology program. Most enrolled in the program are local growers of table and wine grapes and TVCC is renting production space within the UI incubator.

Goals and Outcomes Achieved
Targeted recruitment of specialty crop growers helped the UIFTC make significant progress on goals set in the original grant proposal:

- The center met its projected target by increasing the number of specialty crop growers using the UI commercial kitchen increased from 7 in 2009 to 15 by 2011.
- The number of non-grower clients utilizing local specialty crop content increased from 10 to 20. The target figure of 25 should be reached in 2012.

Obstacles: Due to long delays in delivery of the equipment there is no measurable performance data on the units. The proposal called for purchase and installation of the fruit press by October 2009. The unit did not arrive until early 2011 and has been used thus far only in trial runs. The delay in the fruit press in turn slowed the release of additional grant funds and the bin dryer could not be purchased until later this year. Price increases, particularly in the case of the press, prevented the purchase of a hammer mill and required the expenditure of additional matching funds.

Fortunately, the potential of the equipment does not expire with the project timeline. Given the standard life-cycle of processing equipment, the project will generate returns for 8-10 years. The UIFTC is willing to provide on-going performance data upon request.

Beneficiaries

The most immediate beneficiaries are those local fruit growers who have completed the basic food class and/or those currently working on-site through the TVCC program. Additional growers are anticipated to enroll in the 2012 classes and begin using the equipment.

Lessons Learned

The primary lesson was the difficulty of purchasing equipment with grant funds. There were many variables involved and delayed the progress of the activity some. On the upside, though, the delay has allowed the FTC to develop a more workable protocol. The portable fruit press can move back and forth from FTC to wine incubator and serve more clients. Some growers have an interest in juices but are nervous about production responsibility. They are comfortable growing, but hesitant to expand. Many are also ready for a break after harvest season The FTC is setting up a system to allow contract production with an experienced juice maker who will rent the press from for each project.

Contact Person

Jim Toomey
University of Idaho
jtoomey@uidaho.edu
(208) 454-7616

Adaptation of Lesser-Known Wine Grape Cultivars to Climate Features of the Snake River Valley American Viticultural Area

Subrecipient
Dr. Krista Shellie, USDA, ARS

Project Summary

The initial purpose of this project was to identify novel wine grape cultivars with high potential for commercial production in the Snake River Valley American Viticultural Area (AVA) of Southwestern Idaho. Novel wine grape cultivars are needed in the Snake River Valley AVA because the wine grape (Vitis vinifera L.) market has become increasingly competitive on a global scale and the market is dominated by a limited number of well-known cultivars that consumers already associate with distinct, high quality production areas. The climate of the Snake River Valley AVA is unique from the climates of other western wine grape production regions, yet the majority of acreage in the Snake River Valley AVA is currently devoted to the same well-known cultivars that are being grown in areas with well-established quality recognition. Production of well-known, "global" cultivars, such as Cabernet Sauvignon and Merlot, has increased in pace with increased world production of grapes and this increase has periodically resulted in an oversupply. Market saturation of "global" cultivars has stimulated an interest in exotic, new products (varietal wines) that could offer novel opportunities and expand grape sales. Lesser-known, “Old World” wine grape cultivars that produce wines considered less marketable in their traditional production area than “global” cultivars may be well adapted to and produce good quality wines in newly emerging U.S. grape production areas. Evaluation of cultivar adaptation requires multi-season, replicated field trials and seasonal evaluation of vine productivity and fruit quality. The climatic and edaphic features of the Snake River Valley AVA in Idaho are distinct from the climates and soils of most “Old World” wine grape growing areas, in length of growing season, winter cold, precipitation, solar radiation, soil pH and texture. Adaptation of lesser-known cultivars to the distinct growing conditions in the Snake River Valley AVA of Southwestern Idaho has not been evaluated.

USDA established a grape quarantine center at the University of California at Davis, California to provide access for wine grape growers in the U.S. to a pool of exotic wine grape cultivars from “Old World” production regions. As a result, commercial nurseries in the U.S. now have access to a great diversity of lesser-known wine grape cultivars. In 2004, Cooperative State, Research, Education and Extension (CSREES) authorized but provided no funding for a long-term (13 year), multi-state project (http://nimss.umd.edu/homepages/home.cfm?trackID=4034) to evaluate the horticultural performance of wine grape cultivars in this collection to a diverse assortment of growing conditions. Funding for planting and establishment of a trial site in Idaho was acquired in 2008 and 2009 through grant proposals funded by the Viticulture Consortium West. The funding provided by this SCBGP was used to evaluate the vine productivity and fruit quality of 13 lesser-known wine grape cultivars over multiple growing seasons to ascertain their suitability for commercial production in the Snake River Valley AVA.

Project Approach

The field site, situated in a one-acre plot in a commercial vineyard in Nampa, Idaho, was managed by

Winemakers, LLC who maintained the experimental trial plot in a condition similar to the surrounding commercial vineyard. The trial plot contained a collection of 13 red and white-skinned wine grape cultivars from Portugal, Spain, Austria, Italy and France that were planted in 2008 and 2009 as 4-vine panels in a block design with six replications in north to south oriented rows on a south-facing hillside. Research activities under this SCRGP began in September of 2010 when a Boise State University (BSU) graduate student, Jacob Cragin, was recruited by Dr. Marcelo Serpe (BSU) to initiate project activities with Dr. Krista Shellie (USDA-ARS). The graduate student collected, analyzed, and reported results of field and lab data according to the timeline delineated in the amended project proposal. Pruning weight and winter injury were evaluated in the spring of 2010, 2011 and 2012. Viticultural performance and cold hardiness were evaluated during the 2011 and 2012 growing seasons. Metrics of vine performance included: Vine size (annual cane pruning weights); bud survival; fruitfulness: crop load; berry weight; crop weight per vine; cluster number per vine; cluster weight; berries per cluster; fruit maturity (°Brix, pH, TA); ravaz index; phenology (date of 50% bud break, bloom, veraison; harvest date); cold injury rating; winter bud and cane cold hardiness determined by differential thermal analysis. Dr. Krista Shellie ensured that scheduled activities were completed in a timely fashion throughout the grant period and provided all required quarterly and semiannual reports to the designated individual at the Idaho State Department of Agriculture.

Dr. Shellie also coordinated periodic meetings between BSU cooperator Dr. Marcelo Serpe, BSU graduate student Jake Cragin, and Winemakers LLC to discuss cultural practices and trial management. The purpose of the bimonthly meetings between Dr. Marcelo Serpe, Jake Cragin and myself (Dr. Krista Shellie) were to discuss data collection methodology and progress, data management, data analysis and interpretation of results. In one of these meetings in the first year of the project there were two additional researchers who contributed ideas on data collection. Meetings with Winemakers LLC were with the vineyard manager of Skyline and Sawtooth vineyard and Dr. Shellie or Jake Cragin and occurred informally in the field about every two weeks throughout the growing season. The purpose of these meetings was to coordinate management of vines in the trial plot, including weed removal, trellis repair, irrigation scheduling, shoot thinning, pruning, etc.

Goals and Outcomes Achieved

This project generated new knowledge about the adaptation of lesser-known wine grape cultivars to the Snake River Valley AVA and provided graduate student training in viticulture. No such information or student opportunity was available prior to this project. The new information was made available to the Idaho wine industry in two oral presentations presented at their annual meetings in 2011 and 2012, at which there were 40 to 50 attendees. Information was shared with the research community by presentation of a poster at the 63rd annual meeting of the American Society for Enology and Viticulture (ASEV) in Portland, Oregon and will be submitted for publication in a peer-reviewed scientific journal at the completion of year two data collection (2013). The poster was on display for two days at the ASEV annual meeting, during which at least 50 percent of the 600 participants viewed the information.

Measurable outcomes were also met by submitting oral and progress reports of Idaho trial data to members of the multistate NE-1020 Cultivar Evaluation project at annual meetings held in 2010 and 2011. The 2011 annual meeting of the NE 1020 project was held in Boise, ID and participants had the opportunity to tour the Idaho trial site. Methods of vineyard establishment, data collection, and work

plan for the Idaho trial site followed the protocol developed in the NE l020 multi-state project to enable comparison of Idaho trial results with those of other trial sites.

The start of this project was amended to begin in September 2010 due to delays in graduate student recruitment.

Beneficiaries

Results from this project benefitted the Idaho Wine Industry by identifying cultivars with commercial potential for production in the Snake River Valley AVA. The Idaho Wine Industry experienced a 17% growth rate in 2008 and had, in 2008, an estimated economic impact of $73 million. If one of these well-adapted, lesser-known cultivars, such as Trousseau, were to be planted commercially in the Snake River Valley AVA, its potential economic impact could meet or exceed the current rate of $1200 per ton. Adoption of a novel cultivar identified through this project could enhance the competitiveness of the State's 57 farm entities and 47 wineries, for growing and marketing their grape and grape products.

Lessons Learned

White-skinned cultivars from the Douro and Madeira regions of Portugal, the Niederoesterreich region of lower Austria and the Bordeaux region of France appeared well-suited for production in southwestern Idaho. The cultivar Grüner Veltliner from Austria was the highest-yielding and most cold-hardy of these cultivars. All of the white-skinned cultivars were early to break bud in the spring and reached fruit maturity in 145 to 158 days (Appendix I).

Red-skinned cultivars with extensive acreage in the Dão and Douro regions of Portugal were also well-suited for production in southwestern Idaho. The greatest amount of acreage planted with the cultivar Trousseau is found in the Douro of Portugal where it is known as Bastardo. It is referred to by its French name, Trousseau, in the Jura region of east, central France. Trousseau/Bastardo reached maturity early, produced fruit with high sugar and was more cold hardy than the other Portuguese cultivar Touriga Brasileira. Tinta Cão was the only red-skinned Portuguese cultivar from the Douro region that did not perform well in Idaho. The planting material for this cultivar appeared weak upon arrival, was cold sensitive and never became established. This cultivar warrants re-evaluation with material sourced from a different nursery.

The red-skinned cultivar, Graciano, from the Rioja region of Spain was not well-suited for production in southwestern Idaho because it was late to mature and produced fruit with high juice acidity.

The red-skinned cultivars from Italy, Aglianico, Aleatico and Montepulciano, were sensitive to cold and therefore not suitable for production in southwestern Idaho. In addition to its sensitivity to cold, the cultivar Aglianico was also late to mature. The cultivar Montepulciano from the Tuscany region of Italy never became established due to cold injury and did not produce any fruit.

Contact Person

Dr. Krista Shellie
USDA Agricultural Research Service
Krista.Shellie@ars.usda.gov

208 722-6701 ext. 219

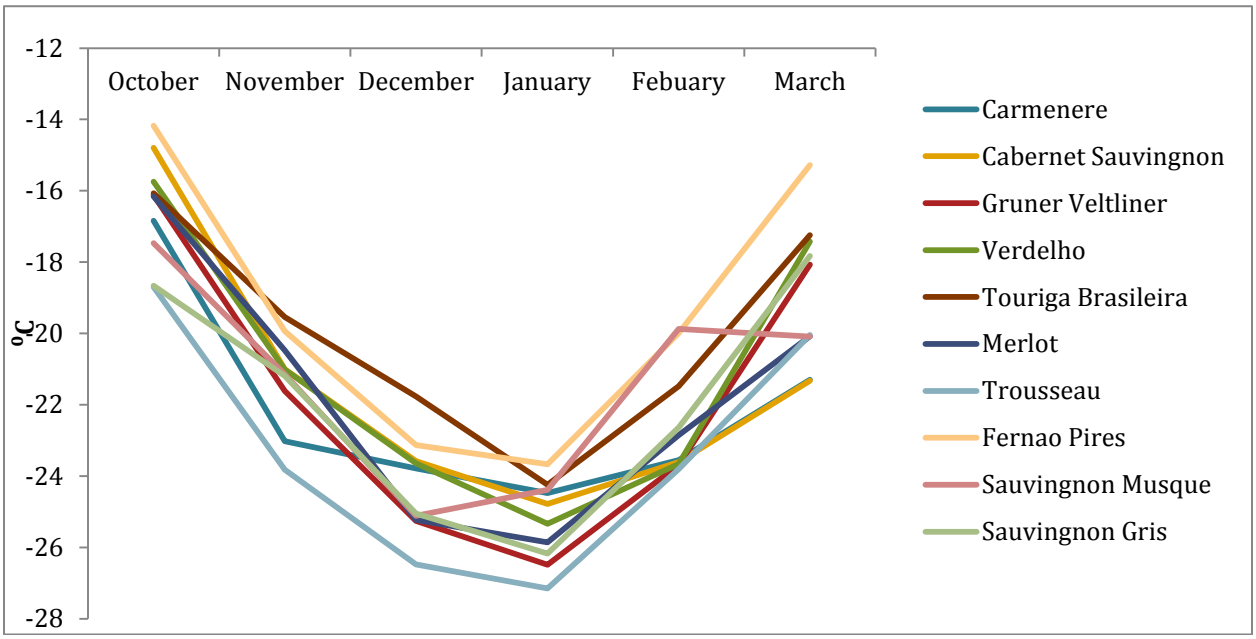
Additional Information

1. Jacob Cragin, Markus Keller, Marcelo Serpe and Krista Shellie. "Disentangling dormancy and cold-hardiness in wine grape cultivars Cabernet Sauvignon and Chardonnay". Poster presentation at the 63rd Annual Meeting of the American Society for Enology and Viticulture, Portland Oregon, June 18th, 2012. Technical abstracts. Page 131. http://asev.org/national-conference-2012/technical-abstracts/
2. Jacob Cragin and Krista Shellie. Oral presentation at the annual meeting of the Idaho Grape Growers and Wine Producers Commission, Caldwell Idaho, February, 2012.
3. Dr.'s Shellie and Keller. Oral Presentation and field tour of trial plot. Annual meeting of the Multistate NE 1020 Coordinated Wine Grape Cultivar Evaluation project, Boise Idaho, November 2012.
4. Publication of 2011 and 2012 results in peer-reviewed scientific journal is projected for spring of 2013.

Appendix 1. Summary of the vine productivity and fruit quality traits for 13 red and white-skinned wine grape cultivars from Portugal, Spain, Austria, Italy, and France grown in a research trial plot at Sawtooth Vineyard in Nampa, Idaho.

Cultivar	Skin color	Origin	2010 live %	2011 live %	2010 Fruit %	2011 Fruit %	Cold Injury %	Days to Mature	DOY BB	Yield (kg)	Cl wt (g)	°Brix	pH	TA (g/L)
Trousseau/Bastardo	R	Portugal (Dao)	92	96	38	100	11	**139**	134	6.9	245.1	26.0	4.3	4.0
Touriga Brasileira	R	Portugal (Douro)	96	96	96	100	14	152	134	10.2	230.2	19.8	3.8	4.8
Tinta Cão	R	Portugal (Douro)	**21**	**33**	**8**	**0**	**100**	No fruit	>140					
Verdelho	W	Portugal (Madeira)	96	88	96	88	17	145	128	6.9	140.9	24.0	3.7	5.6
Fernao Pires	W	Portugal (Douro)	96	92	88	100	16	158	128	6.8	200.2	24.2	3.6	6.7
Graciano	R	Spain (Rioja)	96	92	46	96	2	**171**	134	6.8	236.9	19.8	3.3	8.1
Gruner Veltliner	W	Austria (Niederoesterreich)	100	100	92	96	9	152	128	8.7	256.2	23.7	3.9	3.6
Aglianico	R	Italy (Campania)	88	92	67	96	43	**171**	134	7.7	230.4	22.2	3.1	12.3
Aleatico	R	Italy (Salento)	79	92	33	100	31	155	131	6.9	202.6	22.4	3.5	7.1
Montepulciano	R	Italy (Tuscany)	**58**	**58**	**0**	**21**	**88**	No fruit	>140					
Carmenere	R	France (Bordeaux)	100	100	83	100	11	155	131	3.3	184.2	20.1	3.8	5.1
Sauvignon blanc Musque	W	France (Bordeaux)	100	100	92	100	13	145	128	7.8	164.3	24.2	4.0	4.9
Sauvignon gris	P	France (Bordeaux)	96	96	96	100	9	145	128	6.2	167.4	25.7	4.1	4.2

Appendix 2. Temperature at which 50% of buds were killed as detected by low temperature exotherm (LTE) during programmed exposure to sequentially colder temperature in a programmable freezer.



Appendix 3. Photos of grape clusters of select Portuguese cultivars.

a. Trousseau.

b. Fernao Pires

c. Verdelho

Increasing Fruit Quality and Global Competitiveness of Idaho Apple through Efficient Use of Water, Nutrition, and Orchard Design

Subrecipient
Idaho Apple Commission

Project Summary
In a long-term study, the use of crop evapotranspiration (ETc) when a precise crop coefficient value (Kc) was used provided a reliable tool (irrigation scheduling) for determination of water requirement for 'Autumn Rose Fuji' apple (Malus × domestica Borkh). In this process, the crop coefficient was modified by percentage of ground shade (GS) and tree canopy maturity (M). Water use, tree growth, yield, and fruit quality attributes at harvest were examined under various irrigation systems that were scheduled using ETc. The average rainfall when trees were immature or at an early stage of maturity was 66.0 mm, while when trees were fully grown, it was 55.1 mm. Application of water through a drip system resulted in significantly lower water consumption as compared to applications through micro-jet sprinkler. When trees were mature, each tree with a micro-jet full sprinkler system (FS) received an average of 6461.7 liters (994 mm) of irrigation water per growing season, while each tree with a full drip system (FD) received 3996 liters (614.1 mm). Using a partial root zone drying regime through a micro-jet sprinkler system (PRS) reduced fruit size, but slightly improved fruit color. In general, any deficit drip irrigation regime (65% of full-drip) initially increased yield due to induction of stress and the production of higher number of fruit spurs. However, production declined when the water-deficient treatment was repeatedly applied to the trees over several years. Application of water at 65% of full drip rate, applied on both sides of the tree row (DD), reduced fruit weight. However, when 65% of full drip rate was applied to only one of the alternating sides of the tree every other week (PRD), fruit was heavier than those with the DD treatment. Averaging values over all years indicated that fruit from trees with PRS had higher SSC and the difference was highly significant in 2004 when trees were young. However, trees with FS systems had slightly lower SSC when trees were mature (after 2005). Considering tree growth, yield, and quality attributes in this study, a well-calculated ETc-based full drip irrigation system (FD) is recommended over any other irrigation regime. Application of 40 to 60 grams of nitrogen per tree was sufficient for production of high quality fruit in 'Desert Rose Fuji'

Project Approach
Orchard establishment. The project used an experimental orchard previously established at the University of Idaho Parma Research and Extension Center in spring and early summer of 2002. 'Autumn Rose Fuji' and 'Desert Rose Fuji'trees on RN 29 (Nic 29) rootstock (Columbia Basin Nursery, Quincy WA) were planted at 1.52 x 4.27 meters spacing with an east-west row orientation. 'Snow Drift' crab apple on RN 29 rootstock (C & O Nursery, Wenatchee, WA) was planted in each row as a pollinizer between every 10 'Autumn Rose Fuji' tree. The experimental site had a semi-arid climate, with an annual precipitation of about 297 millimeters and a sandy loam soil of pH ~ 7.3. Crested wheatgrass [Agropyron cristatum (L.) Gaertn.], a drought tolerant grass, was planted as the orchard floor cover in all treatments.

Trees were trained into a vertical axis system during the dormant season in early March every year. Tree leaders were maintained at about 3.7 meters height. Trees in all treatments were blossom-thinned at about 80% bloom with 5% lime sulfur, followed by one or two applications of post-bloom thinners. The first post-bloom thinner was a mixture of carbaryl (44.1% by weight a.i.; Sevin XLR; 1-naphthyl N-methylcarbamate; Bayer Crop Science; Research Triangle Park, NC) and Ethephon (21.7% a.i.; Ethrel [(2-chloroethyl) phosphonic acid]; Bayer Crop Science; Research Triangle Park, NC) each at a rate of 0.187% of formulation and was applied at petal-fall. The second post-bloom thinner (when applied, depending on the crop load) was carbaryl (Sevin XLR) at 0.125% to 0.187% formulation that was applied when fruitlet diameter was about 7 millimeters. Fruits were subsequently hand-thinned when fruits were about 18 milimeters in diameter (around mid-June) to maintain a space of at least 12.5 to 15 centimeters between fruits. Kaolin (95% a.i.; Surround; Englehard; Iselin, NJ) was sprayed for sunburn protection at the rate of 56.8 kg.ha-1 in early July, followed by three one-week interval applications, each at 28.4 kg.ha-1 every year.

Cultural practices other than irrigation were similar to those recommended for commercial orchards in the Pacific Northwest.

Irrigation regimes for Autumn Rose Fuji'. Five irrigation regimes were applied on each of the five experimental rows. A row of guard trees was used between every two experimental rows. These trees received only drip irrigation to prevent any possible over-spray from the sprinkler systems in the experimental rows. Trees from the guard rows were not used for any part of the study. The five irrigation regimes in this study were as follows:

1. **Full Sprinklers (FS)**
   30-cm micro-jet sprinklers (Olson Ultra-jet, Santee, CA) were connected to a lateral polyethylene line installed in a 14-cm deep trench (subsurface), 30 centimeters away from and parallel to the tree row. Each micro-jet sprinkler was installed mid-way between two adjacent trees and covered a complete circle with a radius of 2.1 meters. In this treatment, trees were irrigated once a week at the full rate of evapotranspiration (ETc) for apple starting in 2002 (see "Calculation for water application" below).

2. **Partial Root-Zone Drying Sprinklers (PRS)**
   Two 30-cm micro-jet sprinklers (the same brand as those in FS) were installed mid-way between two adjacent trees and fastened to two lateral polyethylene lines. Each of these sprinklers had a half-circle pattern (180 degrees) with a radius of 2.1 meters and covered either the south or north side of the tree row. At each bi-weekly irrigation cycle, trees were irrigated only with sprinklers on one side and in the next bi-weekly cycle, they were irrigated by sprinklers on the opposite side. At each irrigation time, trees in this treatment received 50% of the FS treatment.

3. **Full Drip (FD)**
   One 16-mm drip line (Rain Bird Corporation, Azusa, CA) was installed in a 10-cm deep trench (subsurface), 30 centimeters away from, and parallel to, the tree row on each of the north and south sides of the tree row. Each of these lines was connected to a pressure regulator to keep the water pressure constant at 1.41 kg·cm-2. Pressure compensating emitters were spaced at 45

centimeters on each line, and each emitter delivered 2.27 L·hr-1 of water. Pressure compensation ensured consistent flow from each inline emitter throughout the entire length of tubing, and the emitter design prevented debris from clogging emitters for maximum performance. The drip line on the north side of the tree was "off-centered" with the line in the south side to provide better water coverage. Trees in this system were irrigated twice a week at 100% of daily ETc (as described below), but adjusted for the ground shading area (GS). Therefore, in this treatment, liters of water applied per tree= (ETc in mm /percent drip efficiency factor) x 1.52 x 4.27 m spacing x %GS.

4. Deficit Drip (DD)

This system was similar to the FD system, except that the amount of water applied in this system was 65% of that applied with FD . This amount was applied to both sides of the trees at each application and frequency of application was the same as that of FD system.

5. Partial Root-Zone Drying Drip (PRD)

With the exception of the frequency of irrigation, this system was identical to DD system. At each bi-weekly irrigation cycle, trees were only irrigated by one of these drip lines, and in the next cycle they were irrigated by the other line. This way, partial root-zone drying was created. The amount of water applied to this system was identical to that of DD system (65% of FD system).

Irrigation regimes for 'Desert Rose Fuji'. Irrigation for 'Desert Rose Fuji' with various levels of nitrogen was similar to the Full Drip (FD) system as described for 'Autumn Rose Fuji'.

Calculation for water application. Irrigation treatments were initiated in about mid-May and terminated in mid-October every year. Shortly before the first irrigation of the year, soil moisture was measured using AquaPro sensors (AquaPro Sensors, Decor, CA) and trees were watered to the soil saturation point. After this general irrigation, water requirements were calculated based on ETc where ETc= ETr x Kc with ETr (Penman-Monteith reference evapotranspiration) (1) being calculated from the Agri-Met Parma Weather Station data and Kc being the crop coefficient. Each year, the crop water use coefficient was calculated as: Kc = Kc base + % M x (mature Kc – Kc base). Percent canopy maturity (%M) was a measurement of tree canopy size and was calculated as: % M = 3.05 + 2.558 x (%GS) – 0.016 x (%GS)2. Kc base was the base coefficient, calculated as the percentage area between the rows that was occupied by a cover crop. In this experiment, spacing between rows was 4.27 meters and the herbicide strip extended 0.61 meters on either side of the row. Thus, Kc base was [4.27-(0.61x2)]/4.27=0.71]. Percentage of ground shading (%GS) was estimated as the area of orchard shaded by the tree canopy at different stages of growth. Since crested wheatgrass was planted as the orchard floor cover plant, value for mature Kc for each month for apple with cover crop, i.e., 0.71 in May, 0.96 in June, 1.04 in July and August, 1.0 in September, and 0.79 in October.

Several random checks were made to test the accuracy of water delivery in various irrigation systems every year. Based on the precision in designing the irrigation systems, and the random checks, an efficiency factor of 100% was assumed for all irrigation treatments. Rainfall during the growing seasons was generally low and when it rained, this amount was subtracted from the ETc value to calculate the actual amount of irrigation needed in each application.

In 'Desert Rose Fuji', trees under Full Drip Irrigation were selected and five levels of nitrogen were applied in five block replications. All growth and quality attributes were measured every year.

Tree growth, yield and quality attributes. For monitoring tree growth, trunk cross sectional area (TCA) was calculated by measuring trunk diameter at approximately 20 centimeters above the bud union (about 12 centimeters above the soil line) in early March every year. For this purpose, two measurements were made, one from the east-west direction and the other from the north-south, the diameter values were averaged, and the radius (R) was computed. Tree TCA (cm2) was calculated every year. Three individuals independently estimated fruit sunburn just before harvest, as percentage of fruit with visible sunburn symptoms on each tree, and the three values were averaged.

Twenty fruits were randomly sampled from each tree from October 17-20 each year. For quality evaluation at harvest, fruits were gently wiped with a damp cloth and percentage of fruit with visible russet was recorded. Fruits were weighed and skin color was visually ranked on a scale of 1 to 5, with 1 = 20% red, progressively to 5 = 100% red. Soluble solids concentration (SSC) was measured using a temperature-compensated refractometer (Atago N1, Tokyo, Japan) and fruit firmness was measured, using an 11-mm probe, with a Fruit Texture Analyzer (Guss, Strand, Western Cape, South Africa). Fruit were cut equatorially in half and the number of fruit with visible water core symptoms was recorded. The percentage of water core was calculated as the percentage of water-cored fruits in the total number of fruit evaluated for quality. Starch degradation pattern (SDP) of equatorial slices of each fruit was recorded by comparison with the SDP standard chart developed for 'Fuji' apples.

Experimental designs and statistics. The experimental design was a randomized complete block with five irrigation treatments and five blocks (replicates). Each block contained 10 trees per plot of each irrigation treatment, of which 5 trees in the center of the plot were used for measurements (i.e., a total of 50 trees per treatment, of which 25 were used for measurements). Analyses of variance were conducted by using SAS (SAS Institute, Cary, NC, USA), with PROC GLM and means were compared by least significant difference (LSD) at $P \leq 0.05$.

Goals and Outcomes Achieved

Work at the University of Idaho:

The main objectives of the project were: To study the influence of five irrigation systems on water requirements and consumption in 'Autumn Rose Fuji' apple, to study the optimum method of irrigation and quantity of nitrogen in 'Autumn Rose Fuji', and to study the effects of five rates of nitrogen, fertigated through a Full Drip irrigation system, on mineral partitioning in the leaf and fruit tissues and relationships between mineral nutrients with fruit yield, and fruit quality in 'Desert Rose Fuji'. The following results were achieved from this project:

1. **Scheduling and Precision to Improve Fruit Quality in 'Autumn Rose Fuji'**

   There was no interaction between year and water treatment for any of the amount of applied water, tree growth, yield, or fruit quality attributes in this study.

   Water application. The average precipitation when trees were not yet fully mature was 66.0 millimeters (Table 1), and the average when trees were mature was 55.1 millimeters. During the irrigation period in all years, July usually had the lowest precipitation. Water application in all irrigation regimes increased as trees matured. As expected, trees used the most water in July and

August in all years. Trees with FS treatment received a significantly greater volume of water than those with drip systems every year. On average, mature trees with a FS system received 6461 liters of water per tree (994 mm), while those with a FD system received 3996 liters of water per tree (614 mm) when trees were mature. Each tree with PRS received more water than those with any type of drip system and more than DD and PRD after trees were mature. Although the volume of water applied to the trees with DD or PRD was only 65% of that applied to the trees with FD system, only minor water stress symptoms were observed in the trees with DD or PRD systems. The symptoms were somewhat more visible in the trees that received PRS irrigation. An obvious visible symptom was that trees receiving less than full levels of either micro-jet sprinkler or drip irrigations had smaller tree canopies and slightly earlier leaf senescence in late October.

Tree growth and yield. Trees with FS and FD irrigation always had higher TCA and more new shoots and foliage (data not shown) than those with other treatments across all years of the study. Trees with PRS consistently had smaller trees than those with other treatments every year, although differences were not always statistically significant.

Trees with all drip systems tended to be more precocious and had higher yield per tree and yield efficiency than trees with FS system. Water stress resulted in a higher production of fruiting spurs in trees with all drip treatments, particularly those with DD or PDR, leading to a higher production in early years. However, yield per tree in the DD treatment was significantly lower than those in FS in mature trees because mature trees in the FS system had larger canopies. Average yield in trees with DD and PRD systems was significantly greater than that of FS and FD systems.

Since trees with a FD system received less water and were more precocious with significantly higher yield per tree than those with a FS system, FD is a preferred method of irrigation over a FS system for 'Fuji' apples as far as yield and water consumption factors are considered.

Fruit color. Fruit color was not consistently affected by irrigation treatment. However, fruit from trees receiving DD and PRD tended to have slightly lower red color than fruit from other treatments.

Fruit sunburn. Fruit from trees treated with FS or FD systems had lower sunburn incidence than those from other treatments every year. Trees from these two treatments had larger canopies and TCA, and more foliage; therefore, fruit had greater potential protection against direct radiation and predisposition to sunburn, which is a significant economic issue to growers.

Fruit soluble solids concentration. Trees with FS systems had slightly lower SSC when trees were mature after 2005. In the present study, any treatment that received deficit irrigation (PRS, DD, PRD) had slightly higher concentrations of dry matter in the leaf when compared with full-irrigation treatments (FS and FD). However, these minor differences did not lead to an increase in the SSC of fruit from DD or PRD treatments.

Starch degradation pattern. Averaging values over all years revealed that fruit from trees receiving PRD treatment had significantly higher SDP than those from other irrigation regimes. Factors that lead to a greater hydrolysis of fruit starch can result in higher soluble solids concentrations in apples. However, a simple fruit dip in iodine solution (SDP) may not always be a reliable measure of the starch concentration of fruit.

Fruit firmness. Throughout this study, fruit firmness at harvest was unaffected by irrigation regime.

2. **Combination of Water and Nitrogen for 'Autum Rose Fuji'**
   Results showed that application of Full Drip irrigation with 40 grams of nitrogen per tree resulted in a much better fruit quality as compared to other treatments.

3. **Nitrogen Fertigation for Desert Rose Fuji**
   Five levels of nitrogen were fertigated through a full drip system to determine the optimum level of nitrogen required for production of high quality 'Fuji' apple. Results showed that application of 40 to 60 grams of actual urea nitrogen is sufficient to produce optimum fruit size and quality in Desert Rose Fuji under conditions of southern Idaho. Application of nitrogen in excess of 60 grams per tree resulted in poor fruit color and quality and shorter storage life and thus not recommended.

4. **Increased Yield**
   This project demonstrated that the optimum volume of water and method of application required for a high density orchard with 622 trees per acre. With Full Drip Irrigation and use of ET-based water scheduling, it was possible to produce 20 kilograms of fruit per mature tree. The project further demonstrated that, when irrigating with optimum full drip system, Bud 9 rootstock at 3 x 12 foot spacing could be used to yield 1210 trees per acre. Thus, with that capacity, the potential exists to produce about 60 tons of apples per hectare. This measurable outcome is a great improvement over traditional orchard system with much lower production and is very close to the goal of 1200 trees and 90 tons of apples per acre listed in the initial proposal.

Work with Cooperators:

As pilot plans, drip irrigations were established at Henggeler and Symms apple orchards, following the outcome of the research at the University of Idaho. Tree performance and fruit quality at the growers' sites with these experimental treatments was outstanding. Many apple growers in Idaho are switching to the Full Drip system and are using the irrigation calculation methods used at the University of Idaho to calculate their water application. They are finding a major saving in both power cost and volume of water used while obtaining higher fruit quality.

Beneficiaries

Fruit Growers Benefits:

This project will have a drastic impact on the Idaho apple industry with over 210 growers, their families, and thousands of Idaho workers working in various sectors of apple production and fruit packing house businesses. First, the project increases the sales and visibility of the Idaho apple in the national and global apple market by increasing production and improving fruit quality through precise and calculated use of water and nutrients. Second, it eliminates contamination of underground water by precise application of nutrients, exactly as needed by plants. Finally, by using the minimum amount of water as having different levels of deficit irrigation systems in this project, it will be possible to find the very minimum volume of water that an apple tree needs to survive in a year with extreme drought when water usage is rationed and must be closely monitored.

Public Education:

a. Due to the extraordinary importance of this project, one of the scientific papers published about this study in the Journal of the American Pomological Society won the First Place National UP Hedrick Outstanding Award among all papers published in 2011. The award was presented to Dr. Fallahi and his scientific team during the annual conference of the American Society for Horticultural Science in Miami in July 2012. The citation for this paper was: *FALLAHI, E., B. FALLAHI, B. SHAFII, D. NEILSEN, G. H. NEILSEN. 2011. The Impact of Long-Term Evapotranspiration-Based Water Scheduling in Various Irrigation Regimes on Tree Growth, Yield, and Fruit Quality at Harvest in 'Fuji' Apple. Journal of the American Pomological Society. 65 (1): 42-53*
b. Over 12 meetings were held with 3 cooperators in their orchards as well as visits with at least 6 members of the Idaho Apple Commission on at least 14 different occasions to discuss details of cooperation.
c. Eleven educational tours were offered to the cooperators and other apple growers to educate them on the irrigating and fertilizing apples. The number of participants in each tour ranged from 120 to over 950 participants, including fruit growers from Idaho and other states.
d. The results were discussed in detail at three annual conferences of the Idaho State Horticultural Society, and at least 220 apple growers participated in each conference.
e. The results were presented at three national conferences of the American Society for Horticultural Science, each with at least 120 participants.
f. The results were presented at three invited international fruit conferences - in Brazil, Italy, and Thailand - each with at least 300 participants.

Lessons Learned

A significantly greater volume of water is required for trees under full micro-jet sprinkler systems than those with drip systems. However, application of water through a drip system, based on full ETc rate and adjusted by percentage of ground shade, can result in major water savings and often improves yield and fruit quality. Application of PRS reduces tree vigor and fruit weight, while sometimes it may improve fruit color and increase SDP. Fruit sunburn is reduced with application of water at full ETc rate in both sprinkler (FS) and drip (FD) systems because trees under these irrigation systems have a larger canopy and more foliage. Considering growth, yield, and fruit quality attributes in this study, a well-calculated ETc-based full drip irrigation system (FD) is recommended over any other irrigation regime for modern high-density apple orchards. 'Fuji' apple trees can be maintained with drip irrigation at 65% of drip ETc rate (i.e., 65% of FD) if certain fruit quality attributes are not of major concern for production. Application of water through a drip system at 65% of full drip ETc rate with the PRD system would be preferred over the DD regime if better fruit size at a reduced irrigation level was desired.

Application of 40 grams of nitrogen per tree in combination of Full Drip (calculation discussed earlier) resulted in better fruit quality in both 'Autumn Rose Fuji' and 'Desert Rose Fuji'.

The project also demonstrated that, when irrigating with optimum full drip system, Bud 9 rootstock at 3 x 12 foot spacing could be used to yield 1210 trees per acre. Thus, with that capacity, the potential exists to produce about 60 tons of apples per hectare. This measurable outcome is a great improvement over traditional orchard system, and by applying the results and lessons learned in this project along with a better training system, it should be possible to produce up to 90 tons per hectare.

With an increasing demand for new cultivars, higher orchard tree density, and different canopy architectures, the impact of various irrigation systems and rates of water application on fruit quality and yield of apples needs to be further studied. Also, a concerted effort by various researchers is required to conduct an extensive study with a uniform set of cultivars and uniform protocol of irrigation over a wide range of climates to reveal the potential interactions between deficit irrigation and apple yield and quality.

Contact Person

Dr. Esmaeil "Essie" Fallahi, Professor and Director of Pomology and Viticulture
University of Idaho
efallahi@uidaho.edu
Telephone: (208) 722-6701

Additional Information

List all publications:

a. Abstracts:

Fallahi, E., B. Shafii, and B. Fallahi. 2011. Fruit Yield and Quality Attributes of Various Strains of 'Gala' and 'Fuji' Apples under an Evapotranspiration-Based Drip Irrigation. HortScience. 46(9): S189.

Fallahi, E., B. Shafii, and B. Fallahi. 2011. "Influence of Rootstock and Irrigation on Mineral Nutrition, Growth, Fruit Quality, and Yield in 'Gala' Apple". HortScience. 46(9): S79.

b. Manuscripts (Refereed):

Fallahi, E., B. Fallahi, B. Shafii, and T.J. McFerson. 2011. The Impact of Rootstock and Irrigation on Water Use, Tree Growth, Nutrition, Yield, and Fruit Quality of 'Pacific Gala' Apple. Acta Horticulturae. Number 903: 915-921.

Fallahi, E., B. Fallahi, M. Amiri, B. Shafii. 2012. Long-Term Fruit Yield and Quality of Various Gala Apple Strain-Rootstock Combinations under an Evapotranspiration-Based Drip Irrigation System. Journal of Fruit, Vegetable and Cereal Science and Biotechnology. Accepted in 2011. In Press.

Fallahi, E., B. Fallahi, B. Shafii, D. Neilsen, G. H. Neilsen. 2011. The Impact of Long-Term Evapotranspiration-Based Water Scheduling in Various Irrigation Regimes on Tree Growth, Yield, and Fruit Quality at Harvest in 'Fuji' Apple. Journal of the American Pomological Society. 65 (1): 42-53.

Development of Virus-Resistant Yellow Bean Seed for Domestic Sale and Export to Mexico

Subrecipient
Idaho Bean Commission

Project Summary
Yellow beans are the most popular beans in Mexico and command the highest price in the marketplace. For the past nine years, the Idaho Bean Commission has worked closely with grower cooperatives and the government in the Sinaloa State, the state that grows the largest quantity of yellow beans. Growers in Sinaloa have asked the Commission to enhance the quality and disease resistance of their yellow seeded beans since the quality of Mexico-bred seed beans cannot compare to Idaho certified seed. Sinaloa growers are not interested in growing other types of beans currently produced in Idaho. With the full implementation of NAFTA in 2008, bean breeders across the U.S. are paying increased attention to developing a yellow seed variety that will perform under environmental conditions in both the U.S. and Mexico. Exports of Idaho seed to Mexico have increased from 23% of market share in 2004 to 52% of market share in 2008. This project could dramatically increase the value of Idaho's seed bean industry to the state. While this project is directly focused on the export of Idaho-produced seed to Mexico, there is potential for the development of domestic markets for yellow beans, especially through U.S. residents of Mexican descent.

Project Approach
The overall goal of this project was to develop Idaho-grown, certified yellow bean seed for sale nationally and for export to Mexico. The purpose of the proposed work was to create one or more virus-resistant Mayocoba germplasm lines in a two year period using marker assisted selection.

Table 1. Origin and number of germplasm lines obtained from a backcrossing program to incorporate different forms of BCMV resistance into Peruano beans.

Pedigree	Number single plant selections
I gene resistance	
Cardinal/FL3//FL3*3	26
Cardinal/Peruano87//Peruano87*3	83
Total	109
bc-3 resistance	
FL3/PS04-114-1-2//FL3*3	19
FL3/PS06-116-2-2//FL3*3	6
Peruano87/PS04-221B-2-3//Peruano87*3	3
Total	28

Figure 1. Peruano germplasm lines in the BC3F1 in spring 2011 greenhouse showing differences in seed and plant characteristics.

The following objectives were pursued:

1. The main objective was to backcross bean common mosaic virus (BCMV) resistance into the Peruano background. Resistance has been well characterized and two genes (*I* and *bc-3*) are the preferred forms of the resistance that bean breeders incorporate into their materials. Molecular markers for these resistance genes have been developed, which reduce the need to conduct virus screening assays when transferring resistance into the target population.
2. The process used to meet the objective involved crossing the virus donor and the Peruano parents, followed by three additional crosses back to the Peruano parent while imposing selection for resistance (either through associated molecular markers or direct inoculation of virus strains). The end product was bean germplasm that possessed 90% of the genes of the original Peruano parents, to which virus resistance has been added (Figure 1).
3. The backcross portion of the breeding process required four generations, followed by additional generations to stabilize the resistance. Using greenhouse and field, three generations per year were possible. Crossing was initiated during the fall of 2009, and BC3F3 families had been obtained by fall of 2011 (Table 1).
4. The backcrossing and molecular marker screening was carried out by the bean breeding program at OSU (J.R. Myers), with support from the breeding program molecular genetics laboratory at that institution. Virus screening was performed at the University of Idaho by the plant virology program (A. Karasev, K. Stewart-Williams) using BCMV/BCMNV isolates from three pathotypes (Figure 2).

Figure 2. Illustration of the symptoms induced in the plants from the cross 1Q inoculated by the BCMNV strain Tn1, and the BCMV strain US10 (mixed infection). Resistant plants are in the back row (no symptoms, no virus infection detectable). Three plants displaying whole plant necrosis are in the front row.

Goals and Outcomes Achieved

Two existing Peruano varieties were used as recurrent parents in the backcrossing process. One was 'Peruano 87', a cultivar developed by INIFAP breeders in Sinaloa, Mexico. The other is a selection (designated FL3) from a Peruano landrace obtained originally from a Florida county extension agent of Peruvian descent by the OSU breeding program. It is later maturing than Peruano 87, but higher yielding. It also became apparent during the breeding process that the FL3 parent was more robust and had a more desirable yellow seed color (Figure 1). These two contrasting types allowed the development of varieties potentially suitable for a wide range of growing environments. Two sources of BCMV resistance were used with one being 'Cardinal' in cranberry market class and a source for the *I* gene, and a series of seven yellow beans germplasm lines developed for Africa by P. Miklas, USDA-Prosser that possessed *bc-3* resistance. These were crossed to the Peruano lines in the fall of 2009, followed by crossing the F_1 back to the respective Peruano parent in the spring of 2010. Prior to the next backcross, all the individuals were screened for the molecular marker associated with resistance and only those lines which possessed the marker were retained. This process was repeated twice. At the BC_3F_2 generation (generated in the spring of 2011), each family was split into two groups, and one was subjected to molecular marker screening while the other was tested using direct virus inoculation. The results from these two tests were combined to select the individuals for generation advance of the BC_3F_3 in the field in 2011. The virus inoculation assay also verified that molecular markers were effective in selecting for resistance and that the linkage between markers and resistance had not been lost due to crossing over. As of the fall of 2011, 109 backcross families with *I* gene resistance and 28 with *bc-3* resistance had been obtained (Table 1). The number of lines using the *I* gene is much larger than those incorporating *bc-3* because in the final virus screening, plants fixed for *bc-3* could be selected, whereas it

was not possible to distinguish among single plants that were fixed and those that were still segregating for the *I* gene. The hope was to find some *I* gene families that did not segregate for markers or resistance, indicating that the resistance gene was fixed, but this was not the case. These will need to be grown for another generation where approximately ¼ of the single plant families are expected to be fixed. The material does closely resemble the original Peruano parents (Figure 1).

Beneficiaries

The beneficiaries of this project include Idaho bean dealers and growers as well of members of the Idaho Bean Commission, all of which have received progress reports on this activity. The members of the Idaho Bean Commission have received annual oral presentations. Idaho bean dealers and growers were given an update at the Bean School in Twin Falls in February 2010, and were given another update at the Bean Schools in Twin Falls and Caldwell in February 2012. Information on the project has also been communicated to Mexican bean dealers at EXPO Chihuahua.

Stakeholders have not yet benefited directly because the germplasm is not yet ready for release. It needs additional generations to stabilize resistance and to self lines to homozygosty. Field trials will be required to narrow the number of lines from 137 to 2 or 3.

Lessons Learned

Overall the backcrossing procedure went according to schedule, and the feasibility of marker assisted selection was validated. At the beginning of the project, there was uncertainty as to whether the *I* gene derived from Cardinal would work in the Peruano background. It is well known in the breeding world that the *I* gene is tightly linked to a seed coat color gene (*B*) and when incorporated into certain market classes, produces unacceptable colors. Cardinal was chosen as the source of the *I* gene because it appeared that the linkage between resistance and color had been broken. It proved to be the case that there was no effect on seed color when incorporated into the yellow seed coat color background. The *bc-3* gene was included as a contingency in case the *I* gene did show a deleterious linkage. It will be important to go forward with both sources of resistance and to eventually combine them to produce "protected *I* gene resistance", which should be nearly impossible to overcome by any new, more virulent strains of the virus that might develop.

Contact Person

Lacey Menasco, Administrator
Idaho Bean Commission
Lacey.Menasco@bean.idaho.gov
(208) 334-3520

Sustainable Production of New Varieties from the Pacific Northwest Potato Variety Development Program

Subrecipient
Idaho Potato Commission

Project Summary
A major quick service restaurant chain announced in 2009 that they would survey all potato suppliers to document pesticide use. This announcement was in response to pressure from shareholder groups that had sought to push a resolution on sustainable production practices. This follows on the recent trend of other major buyers implementing "Good Agricultural Practices" and "Sustainable Agricultural Practices" auditing programs. These programs have been primarily aimed at ensuring food safety, but have recently targeted pesticide use, carbon footprints and environmental impacts. Potato producers in Idaho and other states already strive to optimize applications of inputs, but Russet Burbank (the primary variety grown for processing) is relatively input-intensive due to low resistance to disease and environmental stress. One of the best ways to meet consumer demands for more sustainable potato production practices is through adoption of new potato varieties with increased pest and stress resistance. The Northwest Potato Variety Development Program has released more than 15 new varieties in the past 10 years, many with the ability to produce higher yields and quality than Russet Burbank, with fewer inputs. Although new varieties already comprise 42% of the potato acreage in Idaho, there is a need to further encourage adoption by developing variety-specific management practices, quantifying reductions in inputs, and documenting improved economic returns.

Project Approach
The University of Idaho was contracted to conduct cultural management trials of five recently released potato varieties to document the extent to which fertilizer, irrigation and pesticide inputs could be reduced while maintaining economic returns. Results from these trials were then incorporated into cultural management guides that were used to educate potato growers on best management practices for these varieties. The most significant results from the research trials are highlighted here:

Fertilizer Use
Research was conducted to determine the potential for reducing nitrogen requirements for newly released varieties. Nitrogen responses were evaluated in a series of field trials conducted at Aberdeen, Idaho. In these trials, the nitrogen response of Russet Burbank was compared to Alpine Russet, Alturas, Clearwater Russet, Premier Russet and Umatilla Russet. In each trial, nitrogen fertilizer was applied at 0, 90, 180, 270 or 360 pounds of nitrogen per acre to all varieties; 50% was applied prior to planting and 50% during tuber bulking. To compare the nitrogen use efficiency (NUE) of the new varieties to Russet Burbank, the total yield produced per pound of nitrogen at the point of maximum yield (expressed as cwt/lb N/ a) was determined for each variety (Table 1).

Table 1. Nitrogen use efficiency (NUE) and N requirement of five potato varieties compared to Russet Burbank.

Variety	NUE cwt/lb N/a	NUE % of Russet Burbank	Reduction in N Requirement (%)
Alpine Russet	1.77	118%	15%
Alturas	2.84	170%	42%
Clearwater Russet	2.00	133%	25%
Premier Russet	2.33	139%	28%
Umatilla Russet	1.89	116%	14%

All of the new varieties had appreciably higher NUE values at maximum yield than RB. Improvements in NUE ranged from 70% for Alturas to 16% for Umatilla Russet. The resulting reductions in the nitrogen fertilizer requirement ranged from 42% for Alturas to 14% for Umatilla.

The amounts of nitrogen fertilizer required for the Tri-State varieties adjusted for yield goal are presented in Table 2. The differences between optimal nitrogen fertilizer applications for most of the varieties and Russet Burbank are substantial. For example, for a field with a potential yield of 600 cwt per acre, Alturas would require 130 pounds of nitrogen per acre less than Russet Burbank or a total of 20,800 pounds of nitrogen for a 160 acre field.

Table 2. N recommendations for six potato varieties adjusted for differences in nitrogen use efficiency.

Variety	Yield Goal(400 cwt/a)	Yield Goal(500 cwt/a)	Yield Goal(600 cwt/a)
	----------Nitrogen Rate (lb N/a)----------		
Russet Burbank	240	280	320
Alpine Russet	200	235	270
Alturas	140	165	190
Clearwater Russet	180	210	240
Premier Russet	175	200	230
Umatilla Russet	105	240	275

These results show that the potential for improving the efficiency of nitrogen fertilizer use through the use of these newer potato varieties is substantial. Reducing fertilizer applications by 20-40% per unit of yield produced would not only provide a considerable economic benefit to growers, but would also provide environmental benefits and contribute significantly to the sustainability of potato production systems.

Water Use

Russet Burbank, Alpine Russet, Alturas, Clearwater Russet, Premier Russet, and Umatilla Russet were grown at different water application rates at the Aberdeen, Research & Extension Center in 2010-2011. Each main plot was irrigated according to one of the three irrigation treatments: 100% ET (20 inches) full

season, 75% ET (15 in) full season, and 50% ET (10 in) full season. Evaporation was determined by using the modified Penman estimates provided through the AgriMet system. Irrigation timing was identical for each treatment, with only the length of the irrigations differing to produce the three irrigation rates. The differential irrigation treatments were applied throughout the tuber initiation and bulking stages.

Results were mostly similar for the two years, so the 2010 data will be used to highlight the key learning's. All of the newer varieties produced higher U.S. No. 1 yields compared to Russet Burbank across the wide range of irrigation levels used in this study (Figure 1). With respect to total yield, Umatilla, Alpine and Premier generally produce the highest yields under severe stress. For U.S. No. 1 yields, Clearwater and Premier generally produced the highest yields under severe stress. Of the newer varieties, Alturas exhibited the greatest susceptibility to water stress, due primarily to its relatively large vine and lower proportion of dry matter partitioning to the tubers. All of the newer varieties also had lower percent sugar ends than Russet Burbank (data not shown).

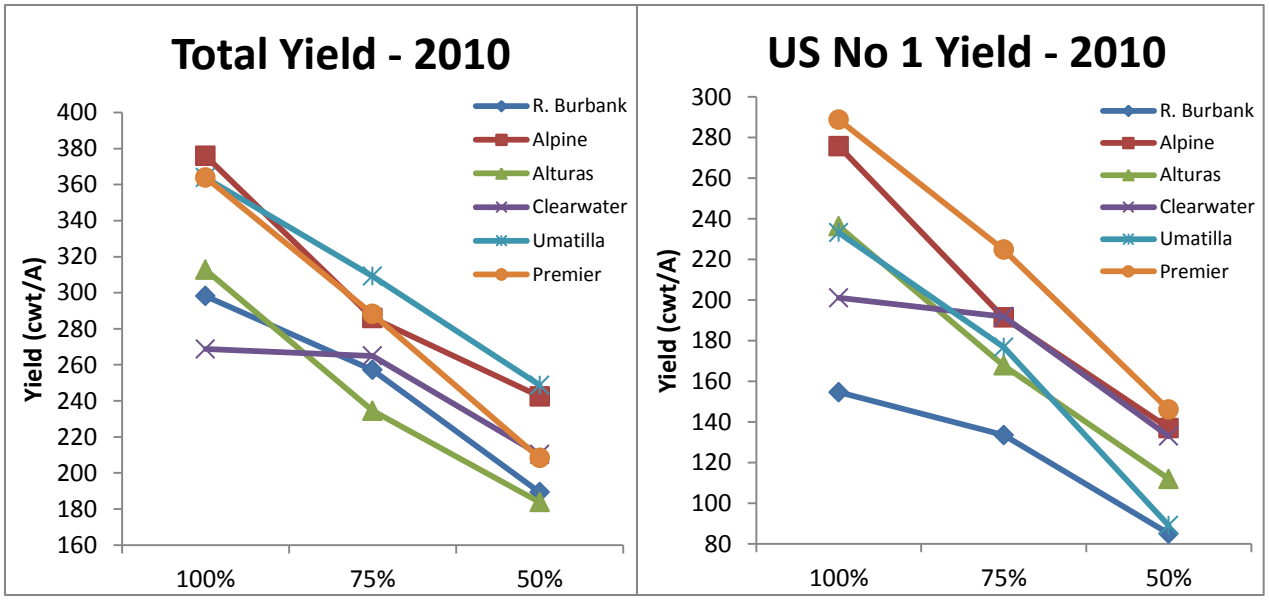


Figure 1. Total and US No 1 Yields for six potato varieties in 2010 irrigated at 50, 75 and 100% ET.

These results show that the potential for improving water use efficiency through production of newer potato varieties is substantial. For example, Alpine, Premier and Umatilla produced approximately 18 cwt in total yield for each inch of applied water in 2010, compared to 15 cwt for Russet Burbank (a 20% improvement). Differences among varieties in the amount of applied water per cwt of U.S. No. 1 yield were even greater. Improved water use efficiency would potentially provide an economic benefit to growers in terms of reduced pumping costs, but would also provide protection from major losses in yield and quality in years when snow pack conditions result in restrictions on water availability for irrigation.

Pesticide Use

Alpine, Alturas, Clearwater, Premier, Umatilla and Russet Burbank were planted in field trials at the University of Idaho Research & Extension Centers in Aberdeen and Parma during 2010-2011 to evaluate the interaction between varietal resistance and the number of fungicide applications or fumigant application rates required to provide disease protection. Although the impact of variety and pesticide

use on the incidence of a wide range of diseases was measured, only the results for early blight were most dramatic and are highlighted here.

Alturas exhibited the greatest resistance to early blight at both locations, while Umatilla had the highest level of foliar infection (Figure 2). Russet Burbank was intermediate in disease incidence, but responded the most strongly of all varieties to multiple fungicide applications in terms of total yield (Figure 3). In contrast, Alpine, Alturas and Clearwater showed very little to any yield response to increasing fungicide applications. This suggests that one fungicide treatment is just as effective in preventing disease and obtaining yields as multiple fungicide applications in disease resistant varieties.

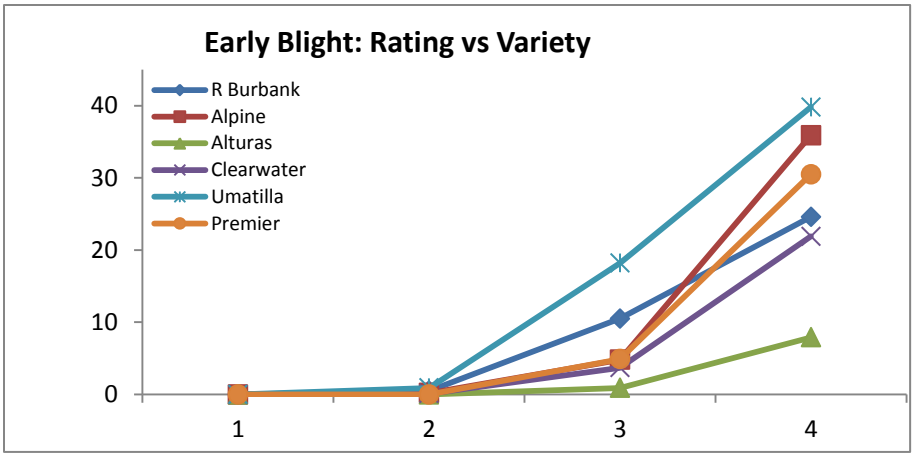


Figure 2. Incidence of foliar early blight infection (% foliage infected) in six potato varieties grown at Parma, ID in 2010. Evaluation dates were July 22, Aug 6, Aug 20 and Sept 3.

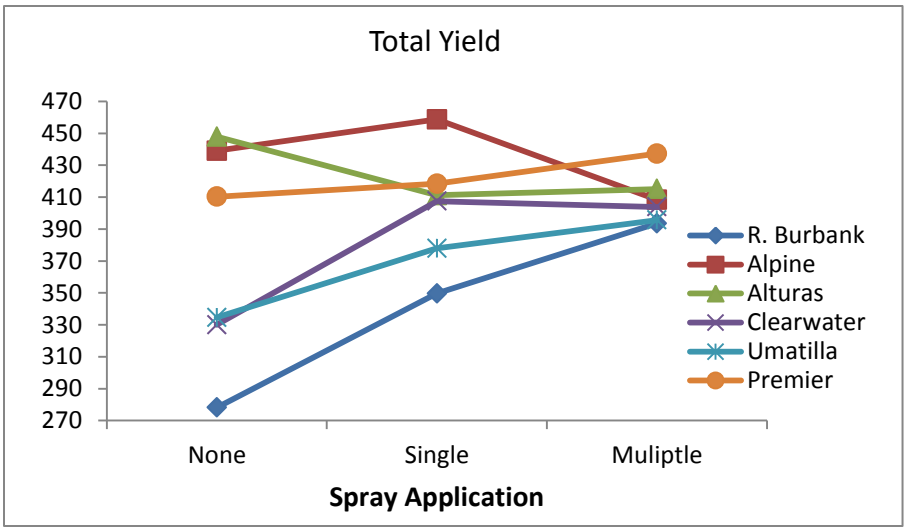


Figure 3. The effect of the number of fungicide spray application on total yields (cwt/ac) of six potato varieties grown in 2010 trial at Aberdeen, ID.

The results from this study show that many new varieties have good levels of resistance to foliar diseases which are commonly found in Idaho. This suggests that growers could achieve significant savings by reducing the number of fungicide applications that they make to their crop in order to control

early blight when growing these disease resistant varieties. If growers are worried about controlling other diseases, instead of reducing the number of fungicide applications made they could reduce the fungicide application rate used.

Economic Returns

Economic viability is a critical component of any sustainable potato production system. A processing (fry plant) contract model was used for the economic analysis in this study. Six metrics were compared to evaluate the relative economic efficiency of the newer varieties in comparison to Russet Burbank. These included: 1) Quality incentive-adjusted price, 2) Total value per acre, 3) Modified gross value per acre, 4) Average price received, 5) Cost of production, and 6) price received/unit of input. The results are illustrated here using the modified gross value per acre value since it takes into account changes in operating costs when inputs are reduced. Data are expressed as a percentage compared to Russet Burbank due to the number of different trials/locations involved. A value above 100% indicates that the new variety is more economically efficient than Russet Burbank.

The new varieties all generated more modified gross value per acre across a range of inputs compared to Russet Burbank (Table 3). Alpine Russet was the most economically efficient variety at the lower levels of nitrogen applied, while Umatilla had the greatest increase in efficiency between low and high N rates. Likewise, Alpine and Umatilla were the most economically efficient varieties at all irrigation levels. By comparison , Alturas and Premier tended to be the most economically efficient varieties across a range of fungicide inputs.

Table 3.Effect of N application rate, irrigation level, and fungicide programs on modified gross value of five potato varieties compared to Russet Burbank (100% = same as RB).

Treatment	Alpine	Alturas	Clearwater	Premier	Umatilla
Nitrogen Rate (lbs/ac)					
0	196%	145%	148%	160%	117%
90	206%	138%	155%	166%	151%
180	218%	150%	177%	171%	165%
270	167%	136%	182%	168%	159%
360	219%	136%	200%	174%	196%
Irrigation level (% of ET)					
50	154%	123%	141%	115%	162%
75	145%	123%	147%	134%	177%
100	190%	149%	124%	151%	193%
Fungicide program (# appl)					
None	114%	134%	119%	119%	107%
Single	163%	164%	145%	166%	144%
Multiple	188%	195%	159%	191%	153%

Goals and Outcomes Achieved

Goal 1 – Create management guides for the cultivars in these trials highlighting ways to reduce inputs and costs, while increasing sustainability.

Cultural management guides were completed for 4 of the 5 new potato varieties in these trials. A management guide for Umatilla Russet was not completed by the University of Idaho team during the period of this project because Oregon State University had previously published management information on that variety.

Goal 2 – Educate 200 growers about optimum cultural practices for new potato cultivars.

Cultural management guides for the new varieties were distributed to interested growers during workshops held at the Idaho Potato Conference in January 2011 and 2012. Additionally, field tours highlighting new varieties were held in the summer of 2010 at Aberdeen and Parma. Total combined attendance at these educational events exceeded the goal of 200. Management guides were also posted on the following websites:

- Idaho Center for Potato Research and Education - http://www.ag.uidaho.edu/potato/index.htm
- Potato Variety Management Institute - http://www.pvmi.org/

Goal 3 – Share information on the role that new cultivars can play in meeting sustainability targets with major potato buyers.

Personnel from potato processing and fresh pack companies in Idaho were specifically targeted during this project to provide them information on the role new varieties can play in meeting sustainability targets. Representatives from all three major processors (Lamb Weston, McCain, and Simplot) and one large fresh pack operation (Potandon) participated in the workshops and field days. Additional meetings were held with personnel from McDonald's corporation to get direct input on how to meet their product quality needs while promoting sustainability through adoption of new varieties.

While not specifically listed as a project goal, the overall objective of this project was to encourage adoption of new varieties as a way to improve sustainability within the potato industry. This is a long-term goal that would not be expected to show results over the two-year period of this project. It is worth noting that during 2011 about 42% of the acreage in Idaho was planted to varieties other than Russet Burbank, compared to 29% in 2002 (a change of 1.3% per year). The Idaho Potato Commission believes that the research and extension activities completed during this project have the potential to accelerate the adoption of new varieties over the next 10 years, resulting in significant economic and environmental benefits to the industry.

Beneficiaries

This project benefited the estimated 100 producers already growing newly released varieties by supplying management recommendations that will allow them to take advantage of potential reductions in pesticide, fertilizer and irrigation inputs. The resulting economic and environmental impacts could be substantial. For example, production of Umatilla Russet, Alturas and Premier Russet in Idaho, Oregon, and Washington was about 48,000 acres in 2011, potentially reducing the amount of nitrogen applied to the soil by 4.8 million pounds compared with the same acreage planted to Russet Burbank. The potential economic savings to NW growers attributed to that reduced nitrogen fertilizer use was over $3.1 million. The reduced use of nitrogen should also significantly decrease the potential

for nitrate-contaminated ground water in the region. Quantifying the economic and environmental impacts of improved water and pesticide use efficiency is more difficult, but should provide similar benefits.

Both the fresh pack and processing industries, as well as the associated buyers that are implementing sustainability initiatives, should benefit from this project. The results provide quantifiable data as to the extent that fertilizer, water and pesticide input efficiencies can be improved by adoption of new varieties, and allow buyers to calculate the environmental impact on their business. This information also meets the demands of consumers interested in sustainable food production, and provides incentives for adoption of new varieties within the potato industry.

Lessons Learned

This project clearly documents the improved efficiency of newly-released potato varieties in terms of yield-per-unit of fertilizer, water and pesticide inputs compared to Russet Burbank. The magnitude to which production efficiencies can be improved was a surprise (70% increase in nitrogen use efficiency, 20% in water use efficiency, and 50% reduction in fungicide applications). This clearly points to the need to continue current variety development efforts as a way to promote sustainable potato production in the future, as no other production system changes are likely to have this large of an impact.

However, it should be pointed out that identification of new varieties that will gain significant commercial acceptance will continue to be a challenge. For example, the original intent was to include two different varieties (Gallatin Russet and Bannock Russet) in these trials. Unfortunately, interest within the processing industry in these varieties did not meet expectations, and it was decided to substitute Alturas and Umatilla Russet since they are already grown on significant acreage. One of the factors identified during this study that can quickly lead to lack of market acceptance is processing quality. The extent to which new varieties are scrutinized in terms of finished product characteristics relating to texture, color, and flavor was a surprise to the UI potato variety development team. The team underwent two days of intensive training by industry experts to better understand these quality attributes, and it is hoped that this level of cooperation will lead to improved variety evaluation procedures in the future.

Contact Persons

Idaho Potato Commission
Patrick J. Kole
Vice President, Legal and Government Affairs
patrick.kole@potato.idaho.gov
(208) 334-2350

University of Idaho
Dr. Mike Thornton
Plant Physiologist
miket@uidaho.edu
(208) 722-6701

Additional Information

Management guides for Alpine, Alturas, Clearwater and Premier are attached as pdf files.

Premier Russet Management Guide - Idaho

General Description

Premier Russet is a product of the cooperative USDA/ARS, University of Idaho breeding program in Aberdeen, and was released jointly by the USDA/ARS and the experiment stations of Idaho, Washington, and Oregon in 2006. It is a mid-to late season, dual-purpose variety notable for its high yield of oblong-long, medium-russeted tubers, high specific gravity, excellent fry color from cold storage and resistances to sugar ends, tuber malformations and most internal and external defects. It is highly resistant to the accumulation of reducing sugars following long-term storage at 40-45 F. Its cold-sweetening resistance allows storage at colder temperatures thereby prolonging tuber dormancy and quality for processing or fresh pack use. Relative strengths include high yield with a very high proportion of U.S. No. 1 tubers, attractive tuber appearance, excellent processing quality and a high level of PVY° resistance. Weaknesses include susceptibility to blackspot bruise, hollow heart, pink rot and dry rot.

Tuber Yield

Premier Russet produced higher average total yields than Russet Burbank in late harvest trials in eastern, western and central Idaho, Oregon and Washington (Table 1). Premier Russet produced substantially higher (108-247 cwt/acre) U.S. No. 1 yields than Russet Burbank at all locations. Total and U.S. No. 1 yields for Premier Russet were slightly higher than Ranger Russet in Western Idaho and Oregon but were slightly lower than Ranger Russet in Eastern Idaho and Washington. Yields of tubers >12 oz were substantially higher than Russet Burbank at all locations but were similar to or slightly lower than Ranger Russet.

Internal and External Defects

Premier Russet had a lower incidence of growth cracks and second growth than Russet Burbank with values more similar to those of Ranger Russet. It is more susceptible to hollow heart than Ranger Russet or Russet Burbank, and similar in susceptibility to shatter bruise. Recommendations are given in the management section regarding cultural practices that can minimize the incidence of hollow heart. Premier Russet is susceptible to blackspot bruise, with ratings comparable to that of, Ranger Russet.

Tuber Quality Characteristics

In 20 trials grown in Idaho, Oregon, and Washington, average specific gravity and solids content for Premier Russet were substantially higher than Russet Burbank and slightly higher than Ranger Russet. Premier Russet also produced significantly lighter fry color than both Russet Burbank and Ranger Russet out of 40° and 45°F storage (Table 2).

Table 1 Premier Russet total yield, U.S. No. 1 yield, and greater than 12 ounce yield as compared to those of Russet Burbank and Ranger Russet in Late Harvest Trials.

Location	Variety	Total Yield	U.S. No. 1 Yield	Yield > 12 oz.
		(cwt/A)	(cwt/A)	(cwt/A)
Eastern Idaho [1]	Premier Russet	471	392	142
	Russet Burbank	426	271	56
	Ranger Russet	496	409	158
Western Idaho [2]	Premier Russet	489	416	118
	Russet Burbank	486	308	86
	Ranger Russet	474	341	138
Oregon[3]	Premier Russet	816	686	319
	Russet Burbank	771	439	134
	Ranger Russet	752	567	305
Washington[4]	Premier Russet	726	632	236
	Russet Burbank	690	455	125
	Ranger Russet	763	642	321

[1] Data from 10 trials conducted from 2001-2005 in Aberdeen, Shelley and Rexburg.
[2] Data from 4 trials conducted from 1999-2005 in Kimberly and Parma.
[3] Data from 11 trials conducted from 2001-2005 in Hermiston, Klamath Falls, and Malheur, OR.
[4] Data from 5 trials conducted from 2001-2005 in Othello, WA.

Table 2 Tuber specific gravity, percent solids and fry color of Premier Russet as compared with Russet Burbank and Ranger Russet.

Characteristic	Premier Russet	Russet Burbank	Ranger Russet
Specific gravity[1]	1.086	1.078	1.084
Fry color (45°F storage)[2]	0.5	1.5	1.2
Fry color (40°F storage)	1.5	3.5	3.2
Solids (%)	22.45	20.25	21.78

[1] Specific gravity data from 35 trials grown in Idaho, Oregon and Washington.
[2] French fry color data from 14 (40 and 45°F) trials grown in Idaho.
USDA color chart [00 (lightest) – 4.0(darkest)]

Processing Characteristics

Premier Russet is notable for the production of tubers with low concentrations of reducing sugars even following long-term storage at 42 F. Russet Burbank glucose concentrations spike above the acceptable level of 0.10% at 42 F prior to 50 days of storage, whereas Premier Russet glucose concentrations remain below 0.05%, and are acceptable for processing even following 250 days of storage.

The reduced accumulation of reducing sugars in tubers of Premier Russet is reflected in consistently acceptable fry color scores (≤2.0) following storage of tubers at 42 to 45 F. In trials conducted in Idaho, Oregon, and Washington, Premier Russet consistently had greater fry uniformity between the stem and bud end of tubers than either Ranger Russet or Russet Burbank. Reducing sugar concentrations in tubers of Premier Russet were 37%-71% lower than Ranger Russet and Russet Burbank across all three states. The dormancy of Premier Russet is shorter than that of Russet Burbank and slightly longer than Ranger Russet based on the percentage of sprouted tubers and average sprout length.

Disease Reactions

Premier Russet is more resistant to Verticillium wilt than either Russet Burbank or Ranger Russet and more resistant to common scab than Ranger Russet (Table 3). However, it is susceptible to pink rot. Its susceptibility to powdery scab is similar to Russet Burbank, but it is more susceptible to powdery scab than Ranger Russet. Its resistance to foliar and tuber early blight and late blight is similar to Russet Burbank, but is slightly better than Ranger Russet for foliar early blight and tuber late blight resistance. Premier Russet is very susceptible to PVX and PLRV, although it is only moderately susceptible to PLRV net necrosis. However, it is highly resistant to PVY^{o}, which should be a major advantage in seed production, although it is susceptible to PVY^{n}. Resistance to corky ringspot and Fusarium dry rot is similar to Russet Burbank but it is more resistant to Erwinia soft rot. It also is more susceptible to Fusarium dry rot than Ranger Russet but has similar reactions to corky ringspot and Erwinia soft rot.

Table 3 Disease reactions of Premier Russet (2003-2005), Russet Burbank and Ranger Russet (1996-2005).

Disease/Pest Reaction	Premier Russet	Russet Burbank	Ranger Russet
Vert. wilt[2]	MR	S	MS
Pink rot	S	MS	MS
Scab			
Common	R	R	S
Powdery	MS(r),R(t)	MS(r),R(t)	MR(r),MR(t)
Early Blight			
Foliar	MR	MR	MS
Tuber	MR	MR	MR
Late Blight[3]			
Foliar	S	S	S
Tuber	MS	MR	S
Viruses[4]			
PLRV	VS	VS	S
PVY^{O}	VR	S	MR
PVX	VS	S	R
PLRV Net Necrosis	MS	S	S
Corky ringspot[5]	MS	MS	MS
Erwinia soft rot	MR	MS	MR
Fusarium[6] dry rot	S	S	MS

[1] Responses are defined as very resistant (VR), resistant (R), moderately resistant (MR), moderately susceptible (MS), susceptible (S), very susceptible (VS).
[2] Verticillium - combined from Aberdeen, Idaho and Hermiston, Oregon.
[3] Late blight - Corvallis, Oregon.
[4] Virus responses are based on seed borne infections as determined by ELISA, following field infection with PLRV from aphid vectored source of inter-planted virus infected potato, mechanical inoculation and aphid vectored PVY, and mechanical inoculation with PVX.
[5] Corky Ringspot - Prosser, Washington. Ranger Russet, 2002-2004.
[6] Fusarium - combination of *F. sambucinum* and *F. solani* var. *coeruleum* reactions
[7] (r) = root galling, (t) = tuber

CULTURAL AND STORAGE MANAGEMENT

Studies on cultural and storage management practices for Premier Russet were conducted for several years in southeastern Idaho. Results of these studies also may provide growers in other production regions with a foundation for the development of management guidelines specific for their locale.

Seed Management

Seed spacing trials indicate that the optimal commercial seed piece spacing for Premier Russet on 36 inch rows is 9 to 11 inches. Optimal seed sizes ranges from 2 to 3 oz. with a 5 to 6 inch cm planting depth. *Seed should be checked for dry rot potential and treated with an effective fungicide if needed, due to the susceptibility of Premier Russet to dry rot.* Premier Russet has not been observed as being sensitive to metribuzin when applied at labeled rates.

Recommendations for minimizing hollow heart in southeast Idaho include using 8 to 9 inch seed piece spacings, reducing nitrogen applications early in the season to avoid excessive vine development, avoidance of excessive, early season soil moisture, and later planting if possible—cooler soil temperatures during early tuber development appear to increase hollow heart in Premier Russet.

Premier Russet is susceptible to pink rot. Avoid over-irrigation and treat with an effective fungicide program. Foliar applications of mefenoxam or metalaxyl should be made when the largest tubers are dime-size and then again two weeks later. Mefenoxam/metalaxyl can be applied in-furrow at planting but this has not performed consistently in some areas. Phosphorous acid fungicides are recommended in areas where mefenoxam/metalaxyl resistance is present. Phosphorous acid products should be applied at a rate of 8-10 pt/acre when the largest tubers are dime-sized, and then be repeated on a 14-day schedule for a total of three applications. Post-harvest application of phosphorous acid (12.8 fl oz/ton tubers) can also be effective in reducing pink rot development in storage.

Fertilizer Management

Fertilizer management recommendations were developed based on replicated field trials conducted over 3 years at Aberdeen, ID. Total nitrogen application recommendations for Premier Russet are approximately 75% of recommendations for Russet Burbank (Stark et al., 2004), with most N applied during tuber bulking. For southern Idaho, total soil plus fertilizer N recommendations range from about 180 lb N/acre in areas with a 400 cwt/acre yield potential to 210 lb N/acre with a 500 cwt/acre yield potential and 240 lb N/acre in areas with a 600 cwt/acre yield potential. Nitrogen uptake decreases substantially after August 10 so N applications should not be made after that time. Petiole nitrate sufficiency levels run about 3,000 to 5,000 ppm higher than Russet Burbank early in the season, about the same as Russet Burbank during mid-season and about 2,000-4,000 ppm lower late in the season. Phosphorus requirements for Premier Russet are about 20-30 % lower than those for Russet Burbank.

Irrigation Management
Premier Russet has good tolerance to water stress, but soil moisture should still be maintained between 65 and 80% available soil moisture (ASM) during tuber development and bulking for optimal yield and quality.

Harvest Management
Premier Russet is similar to Ranger Russet with respect to blackspot bruise susceptibility. Consequently, available soil moisture should be maintained above 60% during tuber maturation prior to harvest to minimize tuber dehydration. Bruising can be minimized by optimization of harvest, transport, and cellar piling operations to reduce impacts that contribute to bruising. *Since Premier Russet is also susceptible to Fusarium dry rot, particular care must be taken to minimize bruising during harvest and handling in order to manage this disease. Phosphorous acid applications should be considered going into storage in areas where there is a significant potential for pink rot.*

Storage Recommendations
The following recommendations are based on data collected over a three-year period at the University of Idaho Kimberly R&E Center on Premier Russet potatoes grown in Southern Idaho.

Curing Conditions: Cure at 55°F and 95% relative humidity for 14 days

Storage Conditions: Maintain 95% relative humidity throughout storage. Weight loss is higher in Premier Russet than Russet Burbank.

To minimize weight loss, store at 45°F.

- **Frozen Processing:**42°F holding temperature
- **Fresh Market:** 45°F
- **Dehydration Processing:** 42°F

Sprout Inhibition: Apply CIPC before dormancy break but after curing

- 42°F - apply CIPC between 14 and 120 days after harvest
- 45°F - apply CIPC between 14 and 100 days after harvest
- 48°F - apply CIPC between 14 and 85 days after harvest

Due to the fact that this is a shorter dormancy potato, CIPC residues should be checked to ensure long season sprout inhibition

Duration of Storage: High processing quality persists throughout 250 days after harvest at 42, 45 and 48 °F, although some mottling has been observed after 10 months of storage. Higher tuber shrinkage is typically higher than Russet Burbank in long term storage.

Fusarium Dry Rot: Susceptibility is higher than Russet Burbank, therefore minimize bruising and manage with appropriate fungicides.

"Just" Food for Idaho – Strengthening Local Food Systems through Expanded Low-Income Access

Subrecipient
Sage Community Resources/Idaho Hunger Task Relief Force

Project Summary
The ***"Just" Food for Idaho*** project addressed two important concerns—strengthening local food systems; and increasing food security and nutrition for low-income Idahoans.

The purpose of the project was two-fold: 1) to increase the consumption of locally grown farmers' market foods by low-income, food insecure Idahoans through use of USDA Nutrition Programs such as SNAP/Food Stamp Program and the Senior Farmers' Market Nutrition Program; and 2) to increase the competitiveness and sustainability of Idaho farmers' markets by expanding, developing, and aiding in the development of Idaho's farmers' markets capacity to participate in these USDA nutrition programs. Food Stamps are provided to low-income Idahoans through an Electronic Benefit Transfer (EBT) card—they can use these food stamps to purchase qualified food items at farmers' markets with EBT capacity.

At the time of grant application, Idaho was ranked as the 10th worst state in the nation for hunger in children under age five and 24th overall for food insecurity (USDA, 2008). Over 17 percent of American children are overweight and over 66 percent of adults are overweight or obese. Low-income individuals are particularly at-risk. If current trends continue through 2020, treating the consequences of obesity may consume up to one-fifth of health care expenditures. The federal nutrition assistance programs administered by USDA are powerful tools to help address this problem, reaching one in five Americans in the course of a year by providing food benefits and nutrition education. The USDA Food and Nutrition Services (FNS) recognizes the need to explore new approaches to empower low-income Americans to consume diets that include fruits and vegetables, whole grains, and other healthful foods—particularly through local community food systems that support local agriculture.

As the fuel and economic crisis painfully made many more aware, Idaho's local community food systems are underutilized and local farmers are suffering. At the time of grant application, Idaho had 49 farmers' markets and only three markets allowing food stamps. Idaho remains one of only four states without the Senior Farmers' Market Nutrition Program (SFMNP).

At the *2008 Summit on Hunger and Food Insecurity in Idaho*, over 260 participants from 38 Idaho cities and 25 counties identified "next steps" for hunger relief in Idaho. One important "next step" was to strengthen local food systems through organizing farmers' markets and building local market capacity for low-income access through the food stamp program and the Senior Farmers' Market Nutrition Program (SFMNP). The *Idaho Hunger Atlas: a County-Level Profile of Hunger in Idaho* released in February 2009 also recommended organizing farmers' markets to build local food systems capacity to respond to food-insecure Idahoans.

To accomplish its goals, the project utilized two full-time AmeriCorps VISTA volunteers to conduct focus groups in seven regions of Idaho, with two groups: low-income food insecure Idahoans and local farmers participating in farmers' markets. Feedback from these focus groups included:

1) Inform farmers' markets about consumer interest and potential revenue
2) Inform low-income Idahoans about farmers' market nutrition programs
3) Identify barriers to participation
4) Provide critical input for farmers' market outreach to USDA nutrition program recipients
5) Inform the design of the Senior Farmers' Market Nutrition Program (SFMNP) for Idaho that would provide vouchers to low-income Idaho seniors exclusively for purchase of specialty crop products comprised of fresh, locally grown fruits, vegetables, and herbs from Idaho farmers' markets

Project Approach

The project approach was to utilize two AmeriCorps VISTA volunteers to implement regional discussion groups with farmers' markets across Idaho to ascertain what challenges they might share, possible solutions, interest in gaining new client base through farmers' market nutrition programs such as Food Stamp benefits, and input on the content of the Farmers' Market Workshop at the 2010 Idaho Hunger Summit. Regional meetings were held in geographic hubs of Coeur d'Alene, Moscow, Caldwell, Challis, Pocatello, Twin Falls, and Grangeville with 22 farmers' markets represented. This input was passed on to participants in the 2010 Idaho Hunger Summit as well.

At the same time, focus groups with low-income Idahoans who are recipients, or potential recipients, of the food stamp program were conducted across Idaho. Fifty-seven Idahoans participated in structured focus groups in seven communities: Coeur d'Alene in Kootenai County, Grangeville in Idaho County, Council in Adams County, Horseshoe Bend in Boise County, Challis in Custer County, Fairfield in Camas County, and Malad City in Oneida County. Participants were asked what the barriers were to participating in the food stamp program and specifically about utilizing the local farmers' market.

The project team participated in the 2009 design and application of the Idaho State Plan for the Senior Farmer's Market Nutrition Program to bring this USDA Farmers' Market Nutrition Program to Idaho's markets.

Goals and Outcomes Achieved

Goal: Increase the competitiveness of specialty crops by strengthening the capacity of Idaho farmers' markets to accept USDA Nutrition Programs and increase consumption by low-income and food insecure children and adults in Idaho.

Performance Measure 1:

Senior Farmers' Market Nutrition Program markets participating: target 10 markets in 2010 and 10 markets in 2011.

Outcome:

- Senior Farmers' Market Nutrition Program—first-ever Idaho application was designed and submitted by the Idaho State Department of Agriculture in December 2009 in partnership with the

project staff and farmers' markets. Due to lack of federal funding for new states, Idaho did not receiving funding in 2009, or for a second application submitted in 2010.

- House Bill 513—Idaho Tax Code Bill. Idaho tax code was successfully amended to align with the 2008 Farm Bill which is necessary to allow the Senior Farmers' Market Nutrition Program to operate in Idaho requiring the program to be exempt from specified taxes.

Performance Measure 2:

Increase Food Stamp EBT capacity at local farmers' markets: target 9 markets.

Outcome:

- Eight farmers' markets now accept Food Stamp EBT
- In 2009, Idaho farmers' markets had food stamp revenue of $1,976. In 2010, the revenue had grown to over $22,000 (Garcia, Idaho EBT Program, 2010).
- Seven focused discussion groups held in each of the seven Idaho regions with 22 markets, with input from these discussions being central to design of the 2010 Idaho Hunger Summit and the farmers' market workshop track
- Seven focus groups with 57 Idahoans who are recipients or potential recipients of food stamps were conducted to determine barriers to participating in the program and at markets. The report *ACCESS: Identifying Barriers to Participation in the Food Stamp Program in Idaho* was presented to the Idaho Department of Health & Welfare. Over 70% of participants were enthusiastic about using food stamp benefits at farmers' markets. The remaining 30% either did not have access to a local market or lacked accurate information about the food stamp program and about ability to use benefits at a market. This information is also being used to design education and outreach efforts.
- A pilot 'congregation supported agriculture' project was designed and implemented at the Capitol City Public Market in 2010 and is in its second 2011 season. The Boise Universalist Unitarian Fellowship (BUUF) was recruited to manage the food stamp electronic benefit (EBT) booth at the Capitol City Market from May 2010 through October 2010. They also managed the tokens for newly installed debit cards and the 'fresh fund.' The 2010 Capitol City Public Market pilot reaped revenue of over $7,500 for the first year. The Portneuf (Pocatello) Farmers' Market is considering this model as they implement food stamp EBT at their market.

Performance Measure 3:

Identify Idaho Farmers' Market leadership

Outcome:

- Statewide Idaho Farmers' Market Association Steering Committee was formalized in 2010 with representation of seven markets—Kootenai County Farmers' Market; Moscow Farmers' Market; Nampa Farmers' Market; Capitol City Public Market; Lemhi County Farmers' Market; Wood River Farmers' Market; Pocatello Farmers' Market. In addition, the Idaho State Department of Agriculture and the University of Idaho Extension Education Program are on the committee being convened by the Idaho Hunger Relief Task Force. This committee will guide discussions about development of a statewide farmers' market association.

- Idaho Hunger Summit on Hunger and Food Insecurity—the 2010 conference was designed with input from the statewide focused discussion with Idaho farmers' markets; and guided by the statewide Steering Committee.
  Keynote: USDA Deputy Secretary Kathleen Merrigan -- *Know Your Farmer, Know Your Food.* The Deputy Secretary toured local farms after the keynote address at the Idaho Summit. Summit participants included over 250 people from 43 Idaho cities, 25 Idaho counties, and the Nez Perce Tribe. Farmers' Market Workshop Track Presenter: Diane Eggert, Executive Director, New York State Federation of Farmers' Markets. There were 45 participants in the Farmers' Market Workshop representing markets across each region of Idaho. Private Summit funding was utilized to provide scholarships for registration and travel to assure regional market leaders could participate. A Final Report was disseminated and included the top 5 'next steps' for food security in Idaho. One of those was creation of a statewide farmers' market association in Idaho.

Performance Measure 4:
Report on focus group input on Food Stamp Program and farmers' market program design and outreach planning

Outcome:
- *Growing Together: Connecting Idaho's Farmers' Markets* was disseminated to the farmers' markets and Statewide Farmers' Market Steering Committee and is posted on www.idahohunger.org.
- *ACCESS: Identifying Barriers to Participation in the Idaho Food Stamp Program* was presented to the Idaho Department of Health and Welfare and is being used to design a 'train the trainer' curriculum for use by Idaho organizations, including farmers' markets.

Beneficiaries
Beneficiaries of the "Just Food" project include:

Idaho Farmers' Markets and farm vendors. Focused discussions with 22 Idaho farmers' markets directly impacted the design of the 2010 Idaho Hunger Summit and brought Diane Eggert of the New York State Federation of Farmers' Markets to Idaho for the full-day workshop. Forty-four workshop attendees learned about the importance of statewide farmers' market association and identified such as a 'next step' for food security in Idaho. As a result of the farmers' market workshop, a statewide Steering Committee was formed to design an Idaho Farmers' Market Association.

Low-income Idaho Consumers. Idahoans who are food insecure and recipients of food stamps gained improved access to nutritious specialty crop produce at farmers' markets across Idaho. In 2009, the revenue was but $1,976 and in 2010 this increased to over $22,000. Specifically, the 'Just Food' project was instrumental in over $7,500 in food stamp revenue in the Boise Capitol City Public Market through the faith-based pilot with the Boise Universal Unitarian Fellowship.

Faith Community. The Boise Universal Unitarian Fellowship (BUUF) dedicated a team of over 15 members to the Capitol City Public Market from May 2010 through October 2010 managing the food stamp EBT/debit card booth. The 'Just Food' project evaluation of this pilot effort documents that the BUUF felt this effort was key to their core beliefs and a meaningful investment of time. The BUUF will

continue this effort in the 2011 market season and have committed to mentoring other markets and local faith groups.

Lessons Learned

Public Policy: Senior Farmers' Market Nutrition Program. An unexpected barrier to application for the Idaho Plan for the Senior Farmers' Market Nutrition Program was the requirement that Idaho Tax Code exempt this USDA program from local and sales tax as is the case with the food stamp and WIC programs. Farmers' Markets from across Idaho and 'Just Food' partners educated decision makers and legislators about this USDA program and the need for Idaho's Tax Code to come into compliance with the 2008 Farm Bill. As a result, Idaho's Tax Code was updated to align with the 2008 Farm Bill, including requirements for the Senior Farmers' Market Nutrition Program.

The Senior Farmers' Market Nutrition Program Plan was submitted to the USDA in 2009. However, due to federal budget shortfalls, no new state applications were approved. The application was resubmitted in 2010 and awaits federal determination.

Contact Person

Kathy Gardner
Project Director
kdgardner@cableone.net
(208) 447-8218

Additional Information

Reports produced through the 'Just Food for Idaho' project can be accessed at www.idahohunger.org (Resources page)

1. *Growing Together: Connecting Idaho's Farmers' Markets* (2010)
2. *ACCESS: Identifying Barriers to Participation in the Food Stamp Program in Idaho* (2010)
3. *2010 Summit on Hunger and Food Insecurity in Idaho: Stopping Hunger Before it Begins (November 2010)*

Development of an Economic Threshold for Mint Root Borer in Peppermint

Subrecipient
Idaho Mint Commission

Project Summary
The mint root borer, *Fumibotys fumalis* (Guenee), is a serious pest of peppermint, *Mentha piperita,* in Idaho and all mint growing regions of the Pacific Northwest. Mint root borer larvae feed on the roots and rhizomes of peppermint in the late summer and fall, causing extensive injury that ultimately results in declining yields and shortened stand life. Because they live underground, sampling to determine if mint root borer larvae populations meet or exceed the economic threshold requires soil samples to be taken from individual fields. Accurate soil sampling is labor-intensive, time consuming and requires specialized equipment (i.e. Berlese funnel arrays) not commonly found in grower operations. An economic threshold based on above ground mint root borer life stages (i.e. eggs or adults) would simplify and reduce the cost of sampling and ensure that growers have access to an efficient, accurate sampling method, an essential of an effective, integrated approach to pest management. The objective of this project was to determine if there is a correlation between numbers of mint root borer eggs on mint leaves during July and the number of larvae in soil samples taken after harvest in September. A sufficiently strong correlation would permit relating root borer eggs numbers to the existing economic threshold for larvae, to provide a less expensive and less time consuming method for estimating damaging levels of mint root borer larvae. This project did not build on a previously funded project with the SCBGP or SCBGP-FB.

Project Approach
Initiating an annual mint root borer colony. In May of 2010 and 2011, peppermint plants were collected from a grower field in Payette County, Idaho. Plants were potted, individually caged, and maintained outdoors at the Parma Research and Extension Center. Mint root borer moths were collected from peppermint fields in July of each year using sweep nets. Caged mint plants were infested with collected moths. Eggs laid by these moths were used to infest field plots in 2010 and 2011 and potted mint plants in 2011.

Monitoring mint root borer moth flight. Mint root borer pheromone traps were placed in two 4-year-old peppermint mint fields in Payette County and Canyon County, Idaho in May and June of 2010 and 2011. All fields were furrow irrigated. The number of male mint root borer moths captured at pheromone traps was determined weekly in each field through mid-July to early August. In each year, the field in Payette and Canyon Co. having the highest moth catch in July was used for the study.

Setting up and infesting field plots. In 2010, plots (3 rows x 4 ft.) were established in two, 4-year-old furrow-irrigated mint fields, one in Canyon County, Idaho and the other in Payette, County, Idaho. Plots were infested with mint root borer eggs at the rate of 0, 2, 4, or 8 eggs per row foot (0, 8, 16 or 32 eggs per plot) for three consecutive weeks from July 12 to July 28, when pheromone traps (Trécé, Inc., Adair, OK) indicated mint root borer moth flight was well under way and eggs would be present in the field

(Canyon Co.: 12, 20 and 26 July, Payette Co.: 13, 19 and 28 July). Eggs used to infest plots were reared from adult moths captured as described above.

All plants in the center row of each plot were visually inspected immediately prior to infesting plots. All eggs found on plants were counted and then the appropriate number of mint root borer eggs was distributed uniformly along the center row. Eggs found in control plots were counted and then removed. The total egg count per row foot was determined by summing the number of eggs released and the number of eggs found by counting and then dividing by four. Eggs counts in control plots were set to "0".

Plots were sampled for mint root borer larvae on September 9 in Canyon County and September 14 in Payette County. Two soil samples measuring 1 ft^2 × 4 inches deep were taken from the center row of each plot and processed in the laboratory where the soil was removed from the roots and rhizomes and sifted for mint root borer larvae. The roots and rhizomes were then rinsed with water and placed in Berlese funnels for 48 hours to extract larvae. The two larval counts were summed to arrive at the number of larvae per sample.

In 2011, methods were similar with the following exceptions. Plots were the same size as in 2010, but in order to increase MRB egg density, only the center square foot of each plot was infested, yielding infestation rates of 0, 8, 16 and 32 eggs per square foot. Infestations were conducted on July 26, August 1and August 10 in Canyon County, and on July 27, August 3, and August 9 in Payette County. In addition, control plots (plots receiving no mint root borer eggs) were sprayed with chlorantraniprole (Coragen) at 0.065 pounds ai/acre three times at two week intervals for beginning July 14 to help insure low mint root borer populations in these plots. The center 1ft^2 of each plot was sampled for MRB larvae as described above on September 14.

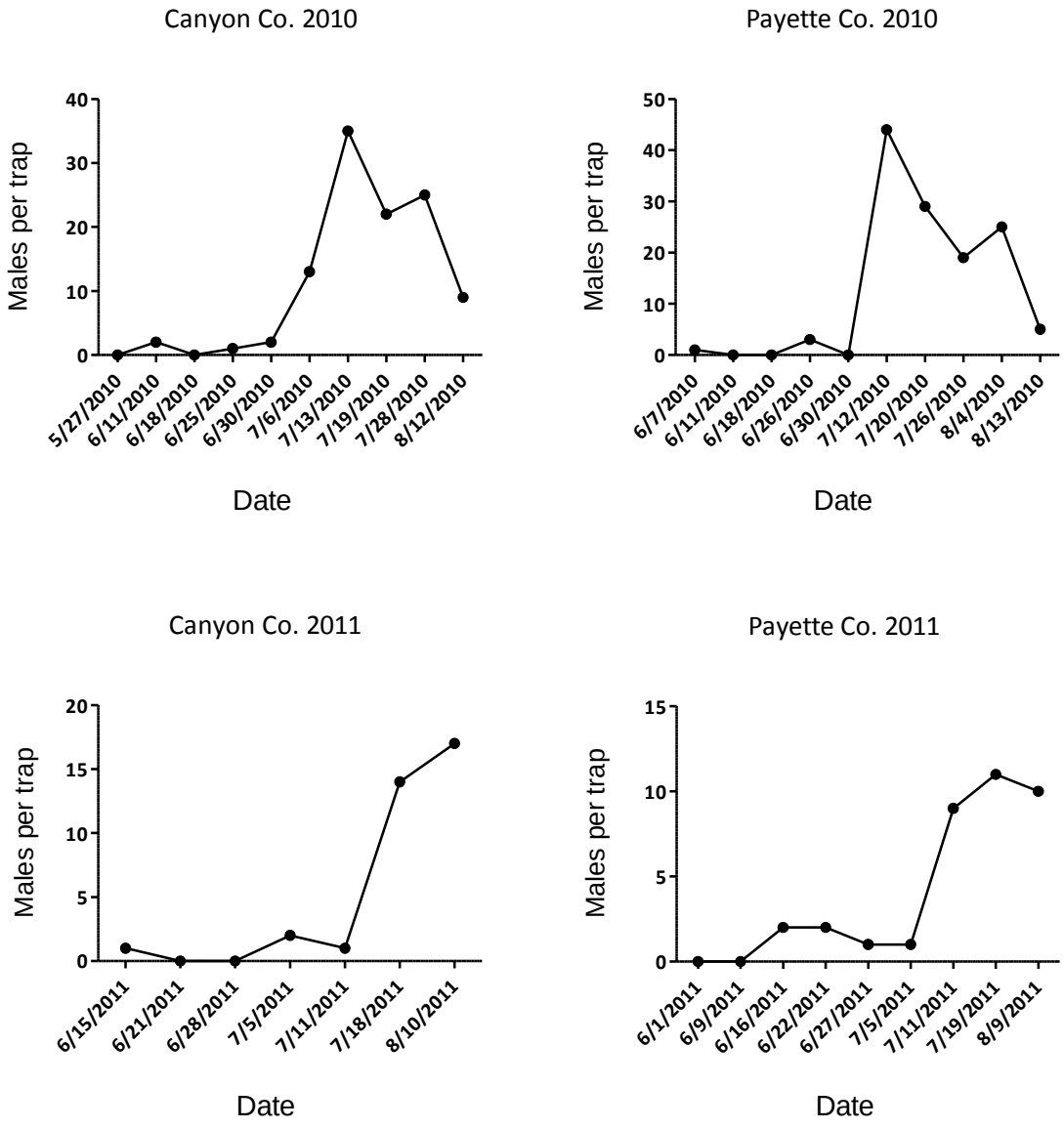
Because a relationship between the number of mint borer eggs in plots preharvest and the number of mint root borer larvae in soil samples post harvest was not observed in 2010 experiments, an additional experiment was conducted in 2011. In this experiment, potted and individually caged peppermint plants (collected as described above) were infested with mint root borer eggs for three consecutive weeks beginning July 26 at the same rate per square foot as the field plots. The treatments were replicated four times. Soil and roots of these plants were sampled on September 22 for MRB larvae as described above.

Data analyses. In both years, the experiment was arranged as a randomized complete block replicated four times (4 release rates x 4 replicates =16 plots in each field). In 2010, the relationship between mint root borer egg number and mint root borer larvae per core was assessed by regressing the number of larvae per sample against 1) the number of eggs found by counting eggs (summed over all three infestation dates) and 2) against the total number of eggs per plot found by counting eggs and by infesting plots. In 2011, insufficient numbers of MRB larvae were recovered to allow analysis, but MRB flight data, egg numbers and larvae numbers are presented.

Results. In both fields in each year, capture of male MRB at pheromone traps was low in June. In 2010, moth flight increased in early July, peaking in mid-late July. In 2011, moth flight increased in mid-July and peaked in late July to early August (Figure 1). In 2010, the mean number of larvae ranged from 4 to 21 per sample and did not increase with increasing number of eggs added to plots (Table 1). Regression

showed no significant relationship, for either field, between the number of larvae per soil sample and the number of eggs found by counting prior to infesting plots (Canyon Co.: F=0.437, P=0.519, Payette Co.: F=0.448, P=0.514: data not shown). Regression of larvae per sample against the total number of eggs found by counting plus the number used to infest plots was also non-significant for both fields (Canyon Co.: F=0.498, P=0.492, Payette Co.: F=1.125, P=0.307: Fig. 2).

Figure 1. Number of male moths captured at pheromone traps in mint fields in Canyon and Payette Counties used in egg infestation experiments in 2010 and 2011 (one trap in each field).



In 2011, a total of only seven MRB larvae were collected from infested plots in both fields (Table 2). This number was insufficient for conducting any meaningful statistical analyses. Likewise, only two larvae were collected from soil and roots of MRB-infested potted plants, also too few for any meaningful analysis.

Table 1. Mean number of MRB larvae per sample for each level of eggs added to plots in the Canyon County and Payette County mint fields in 2010. Eggs were added every week for three consecutive weeks. Added eggs were dispersed evenly over four row feet of the middle row of each plot.

Eggs Added	Canyon		Payette	
	Mean	Std. err.	Mean	Std. err.
0	15.8	2.72	4.3	2.29
8	21.0	6.18	5.0	1.58
16	12.0	1.83	8.8	2.87
32	14.0	5.31	7.3	2.21

Figure 2. Regressions of mint root borer larvae per sample against total number of eggs found by counting and the number used to infest plots. Neither regression was significant. See text.

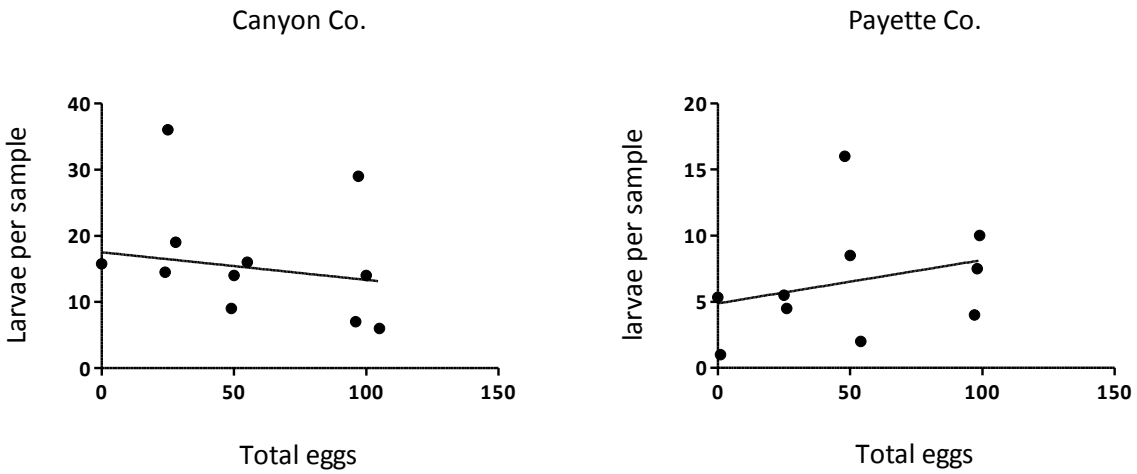


Table 2. Number of MRB larvae recovered from soil samples for each level of eggs added to each plot in the Canyon and Payette Co. mint fields in 2011. Total eggs added is the cumulative number of eggs added over three infestation periods and four replicates of each level of eggs added. Eggs were concentrated in a 1ft^2 area in the center of each plot.

Eggs per ft^2 added	Total eggs added	MRB larvae recovered		
		Canyon	Payette	Potted plants
0	0	0	1	0
8	96	3	1	1
16	192	0	1	0
32	384	1	0	1

Contributions of project partners. Idaho Mint Commission growers provided eight commercial mint fields (furrow irrigated) for monitoring mint root borer populations during the study. Two of these fields were used to conduct field experiments in each year of the study. Growers also provided mint plants for the annual mint colony and experiment using caged mint plants. The University of Idaho has conducted the experiments outlined in the proposal, collected and analyzed data, and provided written and oral reports summarizing the results of the study.

Goals and Outcomes Achieved

All the activities outlined in the proposal were completed; however, a correlation between numbers of mint root borer eggs on mint leaves preharvest in July, and the number of larvae per in soil samples taken postharvest in September was not detected. Therefore, the primary goal of the proposal was not achieved.

Beneficiaries

Beneficiaries of this project are research scientists considering research on mint root borer life stages and/or mint root borer thresholds in mint and Pacific Northwest mint producers.

Lessons Learned

Due to high mortality of mint root borer eggs and larvae, sufficient numbers of mint root borers to establish differences in numbers of mint root borer larvae among infested plots could not be produced. This mortality is due to unknown causes. Future research to establish a relationship between mint root borer eggs on mint foliage and mint root borer larvae on mint roots should first establish a reliable rearing protocol that ensures an adequate infestation level and/or or focus on increasing the number of fields sampled and the number and size of plots sampled for eggs and larvae in each field to ensure adequate numbers of, and variation in, egg and larvae numbers for establishing a correlation.

Contact Persons

Roger Batt, Executive Director
Idaho Mint Commission
Roger@amgidaho.com

James D. Barbour, Associate Professor and Research Entomologist
Southwest Idaho Research and Experiment Station
jbarbour@uidaho.edu

Variety Selection and Evaluation of Growth Regulators, Canopy Design, and Crop Load to Improve Fruit Quality of Idaho Table Grapes for the Global Market

Subrecipient
Snake River Table Grape Growers Association

Project Summary
Excellent climate and soil conditions make Southwest Idaho an outstanding region for production of high quality table grapes. The cultivar and quality evaluations described in this project, as well as canopy design, are of utmost importance and were urgently needed for Idaho's newly-established table grape industry. This project evaluated different canopy designs, new cultivars and selections, and effects of various viticulture practices to improve berry quality of selected grapes. The objectives were: 1) To evaluate new cultivars and their adaptability to the conditions of southern Idaho; 2) To study the effects of crop load management and viticultural practices, including cluster thinning and gibberellic acid on berry maturity and quality of table grapes that have shown promising results; and 3) To evaluate storability of various table grapes in Idaho.

This project was timely for several reasons. First, there are approximately 800 acres of table grapes in Idaho, which may soon increase to 2000 acres, and there is no information on the effects of various canopy systems or new cultivars on fruit quality in this region. Second, table grapes from Southern Idaho are harvested fresh when California grapes are either finished or on the tail end of production. At this time, California grapes are and subject to repeated applications of sulfur dioxide gas in storage and do not have a long storage life. Thus, table grapes can be a high-value specialty crop for a niche market. Third, the price of gas is increasing steadily. A fruit buyer can buy tree fruits as well as table grapes and transfer them together to a shipping port, rather than buying the grapes exclusively from California. Furthermore, transportation of table grapes to major cities in the Pacific Northwest (Seattle, Portland, Boise, Spokane) and the Intermountain west (Denver, Salt Lake City) and Canada would be significantly less expensive from Idaho than from California. Thus, it is an excellent idea to grow table grapes in Southern Idaho. Finally, production of table grapes would easily fit in the existing operation of row crop and existing wine grape growers. It is also an outstanding choice for both small and large scale production in Idaho.

For conducting this research, the ground was prepared and fumigated with Telone 2 before planting. In spring of 2010, 15 promising selections from the University of Arkansas Table Grape Breeding Program were selected and planted at the University of Idaho Parma Research and Extension Center Pomology. In addition to these selections, several new cultivars, including 'Autumn Royal', 'Fantasy', 'Red Globe', 'Emerald', 'Ralli' ('Anahita'),'Strawberry', 'Kashishi', 'Kathie K', 'Princess', 'Autumn King', 'Sweet Scarlet', 'Scarlet Royal', 'Sugar Thirteen', 'Persian Gulf', 'Mehdi Khani', 'Askari', and 'Kandahar' were propagated and added to the experiment in 2011 and 2012. A drip irrigation system was installed during the spring of 2010, 2011 and 2012. Different trellis systems were installed in 2012. Results from established vines of 'Jupiter', 'Persian Gulf', and 'Emerald' and 'Alborz' were very satisfactory and these cultivars can

potentially be recommended at a commercial-scale production under conditions of Intermountain Western USA. 'Persian Gulf'' has a medium berry size, but was more tolerant to fall frost. Quadrilateral cordon was a preferred method for training grapes under conditions of this study. Effects of regular storage on fruit quality and berry storability were studied in certain cultivars including 'Alborz', 'Jupiter', 'Persian Gulf' and 'Red Globe'. 'Red Globe' and 'Persian Gulf' had the longest storage life and with the use of sulfur pads, they could be stored until Thanksgiving and some until Christmas. A quadrilateral cordon or a high T system resulted in satisfactory production and fruit quality.

Project Approach

In 2010, cuttings of several new table grapes, including 15 new selections from University of Arkansas were chosen by the project leader and Dr. John Clark. In addition, 'Autumn King', 'Sweet Scarlet', 'Scarlet Royal', 'Sugar Thirteen', 'Persian Gulf', 'Askari', 'Mehdikhani', and several other cultivars were rooted and planted at the University of Idaho Parma Research and Extension Center. The vine spacing at the University of Idaho is 6 or 7 feet within rows and 12 feet between rows. Vines were trained into a bilateral low and high cordon, alternate bending slanted cordon, or quadrilateral cordon systems. The experimental arrangement was completely randomized design with at least 10 one-vine replicates. In 2011 and 2012, vines that were planted in 2007 and 2008 were mature and initial data was gathered from these vines. During each year, clusters were sampled, and yield and fruit quality attributes, including berry size, color, soluble solids, berry skin characteristics, and cluster weight and shape were measured. Vine performance (survival) was also measured.

Goals and Outcomes Achieved

Work at the University of Idaho.

This project had three objectives:

1) To evaluate vine performance, yield, and berry quality attributes of new selections and cultivars of table grapes and to study their suitability for the conditions of Southwest Idaho, Oregon, and Washington.
2) To study the effects of crop load management and viticultural practices, including cluster thinning, cluster removal, girdling, and gibberellic acid (GA) on berry maturity and quality of table grapes that showed promising results in our earlier evaluation.
3) To evaluate storage life of promising cultivar under a regular cold storage condition.

Cluster removal and cluster cutting, with and without girdling, were practiced in 'Alborz' and 'Emerald' and 'Jupiter'. Alborz vines that received cluster shortening and cluster removal plus girdling had significantly larger berries than control vines. Alborz vines that received no treatment (control) as well as those with cluster removal but not shortened had significantly longer clusters than all other treatments. In 'Alborz', yield and sugar were not affected by cluster cutting or cluster removal in some years. The experiment with the 'Alborz' table grape in 2010 showed that it is possible to have between 20 clusters (when vines are young) to 28 clusters (when vines are mature) while maintaining acceptable berry size, if shoot thinning, cluster cutting and cluster removal and GA application were practiced correctly.

Results indicated that new cultivars such as 'Kashishi', and 'Autumn Royal' and 'Jupiter' may have a great potential and the intent is to continue research on these cultivars in the future.

Overall, three applications of gibberrelic acid, each at 50 ppm, starting at fruit set within a five-day interval showed satisfactory results and produced berries at sizes 12-14 (based on California sizing system).

Effects of regular storage on fruit quality and berry storability were studied in certain cultivars including 'Alborz', 'Jupiter', 'Persian Gulf' and 'Red Globe' and a few other cultivars. In this experiment, 16 boxes of each of the above cultivars were harvested, treated in one of the following treatments, and stored at 0 ^{0}C regular atmosphere storage. Four loose boxes were stored without any sulfur pads. In four boxes, grapes were put in two-pound plastic bags and stored at 0^{0}C without sulfur pads. In the third group, loose boxes were stored with four sulfur pads (two on the top and two on the bottom of the box). In four boxes, grapes were stored in two-pound bags with four sulfur pads (two on the top and two on the bottom of the box). The berry's color, odor, firmness, and rate of spoilage were evaluated one day before Thanksgiving, one day before Christmas and mid-January.

Different observations in this experiment were recorded. In general, grapes with sulfur pads had significantly less spoilage than those without sulfur pads. Also, 'Alborz' grapes with sulfur pads were mostly in a good shape and berries were edible at least until Thanksgiving. 'Alborz' berries, however, had severe fungal infections by Christmas. 'Persian Gulf' and 'Red Globe' had the best storability, and these grapes with sulfur pads were consumable until Christmas. The storage life of Persian Gulf in 2011-12 was shorter than that in 2010-11. Bagging grapes was not helpful for storage, and in some cases, increased spoilage.

Installation and training based on quadrilateral cordon system increased berry yield while did not diminish berry size as compared to control and vines with a single bi-lateral cordon system. Grapes produced under a low double cordon system had greener berries as compared to those under a "high" double cordon system (high T) system.

Working with Cooperators (Growers and Scientists). 'Alborz', 'Emerald', 'Jupiter', 'Anahita', and a few other cultivars from the experiments in Idaho were planted in different sites in Southern Idaho, Oregon and Northern Idaho, and Moses Lake, Washington. In 2011 through 2012, in cooperation with collaborators, we monitored and measure vine growth performance, yield, and berry quality attributes of these cultivars. 'Anahita' was sensitive to spring cold and productivity could be diminished as a result of cold springs. 'Alborz' performance was satisfactory to excellent, depending on growers accuracy in following recommended cultural practices, cluster adjustment, and GA application. Some cooperators who practiced GA application alone or cluster adjustment (tipping and thinning) alone, had better berry size than those who did apply these treatments. Growers who practiced both GA application and cluster adjustment had excellent results (great yield, berry size and quality).

Highlights of Achievements in Comparison with Initial Goals. The initial proposed goals stated that, "In 2008, the benchmark for 'Alborz' is 8 x 9 spacing and the yield is about 10 tons per acre. Idaho table grape is sold at about $0.75/pounds ($16,500/acre; net income of about $10,000/acre). At present, there is no other crop in Idaho generating this level of income. At 6 x 12 foot spacing with a divided canopy of slanted bilateral cordon", (two of the proposed canopy system in this project), and with new varieties we are anticipating to increase the yield by up to 60% , which would translate to $22,349/acre (net of 13,500/acre by 2011. By 2012, yield is anticipated to increase by 80%, $29,799/acre (net of $18,000/acre)." Initial expectations were exceeded due to the fact that by 2012, it was possible to increase yield by at least 90% (10% more than anticipated goal) by the use of quadrilateral cordon training system. Additionally, the price of table grapes is as high as initially estimated.

Also, in the initial proposal, it was estimated that "Partially due to the outcome of this project, the acreages is expected to increase to about 2000 acres by 2012". The actual total acres of table grapes in Idaho in 2012 are estimated to be about 1010 acres (by estimation of the Snake River Table Grape Growers Association). However, following the University of Idaho's Idaho recommendations and guidelines, the acreage of this crop in the neighboring states of Utah, Colorado and Oregon is increasing rapidly. There is not an exact figure for these areas at the present time, but the increasing trend in the table grape production in the region is very promising.

The initial perdition seems to become a reality in stating that "Idaho's growing region would be a late-season region and would be economically profitable for California growers to invest here. Grapes from Idaho are considered a perfect supplement to California grapes as they are marketed at tail end of California grape season. California growers and investors may invest in Idaho, the economical impact is huge". Investors from California are buying Idaho grapes and many new growers are coming to Idaho and starting table grape production.

Beneficiaries

Grape and Other Potential Growers. Numerous growers in Idaho, Washington, and Oregon are using the results of this project to establish table grapes in their areas. Every step of this project is used as a model for this newly established industry in the PNW. Research from this project indicates that, with practices like cluster removal and cutting, it is possible to produce table grapes with excellent cluster and berry sizes in the region. Results indicate that many of the tested cultivars not only mature after California grape production has slowed down or finished, but also have superior berry color and flavor without adding any plant growth regulators. Every year, numerous potential table grape growers visit experiments conducted during the project period, and a large number of growers have added new acres of table grapes. In summary, as a result of this project - the only table grape project in the PNW - the future for table grapes as a new alternative fruit for the Pacific Northwest is bright, and the acreage of the table grape as a brand new industry is increasing rapidly according to the information provided by the Snake River Table Grape Association. Additionally, several sizable overseas buyers have shown interest for purchase of Idaho grapes.

Public Education

a. At least 15 meetings were held with cooperators in their vineyards in addition to visits with the members of the Snake River Table Grape Growers Association (SRTGGA) on different occasions to discuss details of cooperation.
b. At least 14 educational tours were offered to the cooperators and other table growers to educate them on the training of vines, cluster and crop management. In each of these tours, between 60 and 900 people from Idaho and other states participated.
c. In February of 2009, 2010, 2011 and 2012, a comprehensive and intensive "Table Grape School" was offered to table grape growers, with at least 150 participants at each one.
d. The results were presented at a presentation at the International Table Grape Symposium held in California in May 2010 with 550 participants from all around the world.

Lessons Learned

Certain varieties of table grapes can be successfully produced in Idaho and marketed worldwide if crop cluster adjustments, proper site selection, correct GA application (if needed), and proper training (a high T cordon or quadrilateral cordon) are practiced. Research needs to continue on these practices and find newer cultivars that can withstand fluctuating cold temperatures of Idaho and the Intermountain Western USA. Selecting a warm site and cultivars before planting will allow 'Alborz' to be successfully grown in the proper areas. The future is bright and the demand and interest in table grape production is increasing.

Contact Person

Dr. Esmaeil "Essie" Fallahi, Professor and Director of Pomology and Viticulture
University of Idaho
efallahi@uidaho.edu
Telephone: (208) 722-6701

Additional Information

List all publications:

Fallahi, E. 2011. Systematic evaluation of table grapes in search of suitable cultivars for high deserts in the United States. *Journal of Applied Horticulture, 13(2): 96-101.*

Fallahi, E. 2010. Table Grape Production under High Desert Conditions of Southwest Idaho and the Pacific Northwest (a Book, online), In Press.

Improving the Competitiveness of Onion, Potato, Apple, Cherry, and Pea/Lentil Packing/Processing Operations through Training and On-Site Assistance

Subrecipient

Boise State University/TechHelp

Project Summary

Food borne disease is currently responsible for 48 million illnesses, 128,000 hospitalizations, and 3,000 deaths in the U.S. each year, according to the Centers for Disease Control and Prevention. Recent outbreaks of food borne illness have been traced to fresh produce, including spinach, peppers, and pistachios. The recent outbreak of salmonella illness linked to peanut butter has raised awareness of the health risks associated with unsafe handling of produce as well as red meats and poultry. In response, Congress and the Administration are placing greater responsibility on commodity growers, manufacturers and food handlers to prevent contamination risks and document their actions.

In addition to the above, food processors are increasingly required by the companies they supply to adhere to advanced food safety standards including HACCP and GFSI standards. Companies that follow advanced global food safety standards will be much better positioned to compete in domestic and international markets.

The goal of this project was to provide safety and efficiency training and technical assistance to the three target groups that process and pack these commodities in Idaho in order to prevent contamination of their products and to help them run an efficient operation. These groups are: onions, apples and cherries; potatoes; and peas and lentils.

Project Approach

This project was comprised of two main activities: public training workshops and on site assessments for the companies that attended at least one workshop. The following is a list of workshops and number of attendees:

Location	Event Title	Attendees	Hours
Caldwell	Introduction to Food Safety & HACCP for Fruit and Vegetable Packers	26	208
Caldwell	Practical Food Safety & HACCP Workshop for Fruit and Vegetable Packers	11	264
Moscow	Practical Food Safety & HACCP Workshop for Pulse Processors	17	408
Moscow	Introduction to Food Safety & HACCP for Pulse Processors	19	152
Caldwell	Introduction to Food Safety & HACCP for Spanish Speakers	21	168
Idaho Falls	Introduction to Food Safety & HACCP for Potato Packers	52	416
Twin Falls	Practical Food Safety & HACCP for Potato Packers	42	1008
Boise	Northwest Global Food Safety Initiative Workshop	87	2088
Boise	Practical Food Safety & HACCP Workshop for Fresh Fruit & Vegetable Packers & Pulse Processors	33	792

In sum, 308 people spent 5,504 hours in workshop training.

Initially, TechHelp had planned on offering five workshops per target group around the State of Idaho in the following areas:

- Introduction to Food Safety & HACCP
- Practical Food Safety & HACCP,
- Global Food Safety Initiative (GFSI) Standards
- Principles of Lean Manufacturing
- Sustainability

Following attendance at one or more of the above workshops, companies were invited to request a site assessment at their local facility. Site assessments were conducted in person or over the phone by University of Idaho Food Processing Specialist, Jeff Kronenberg. Jeff was invited to assess 18 specialty crop facilities. Jeff contacted all 18 facilities and conducted 17 site assessments. Companies spent approximately 300 hours participating in the assessments. Each site assessment was focused on food defense and food safety practices and sustainability (energy, environment) where appropriate. Each facility was given feedback and recommendations via a written report or verbal communications.

Partners in the project included the University of Idaho, the Idaho Grower Shipper Association, the Idaho Oregon Fruit and Vegetable Association, and the USA Dry Pea and Lentil Council. Jeff Kronenberg, Food Processing Specialist from the University of Idaho completed all the site assessments and either taught or selected and vetted speakers for all the workshops. The Idaho Grower Shipper Association, the Idaho Oregon Fruit and Vegetable Association, and the USA Dry Pea and Lentil Council assisted in marketing and advertising workshops to their members. They also provided guidance on the needs of their members including which workshops would benefit their members most.

Goals and Outcomes Achieved

Goal in Application

Achievement of the goal to improve the food safety and efficiency practices of Idaho's onion, potato, apple, cherry and bean packers and processors will be measured by:

1. Percent improvement in food safety prerequisite program and HACCP audit scores
2. Percent of participating companies initiating efficiency improvement activities
3. Percent of participating companies initiating sustainability activities

The partners estimate that the project will result in 75 percent of the participating companies reporting at least a 10 percent increase in their audit scores. In addition, 20 percent of the companies will initiate an efficiency improvement activity and 10 percent of the companies will initiate a sustainability activity.

Progress or Accomplishment

Benchmark data for these performance measures did not exist publicly prior to this project and collection of the data from clients proved difficult due to the sensitive nature of the information. One site assessment resulted in a Sustainability or E3 project with a fruit and vegetable packer in Eastern Idaho. As this project is not yet complete, economic impact data is not available. Potential impacts include energy and cost savings in lighting, compressed air, and waste water. Another site assessment

resulted in a Food Safety Audit Gap Assessment project with a pea and lentil processor. This project is ongoing so economic impact data won't be available for another six to twelve months. The percent of companies initiating efficiency improvement and sustainability activities is not yet available. This information will be collected in a survey six to twelve months from the activities' completion.

Goal in Application

Progress towards the performance targets was measured by initial tracking of the number of hours committed by companies to workshops and to assessments.

Progress or Accomplishment

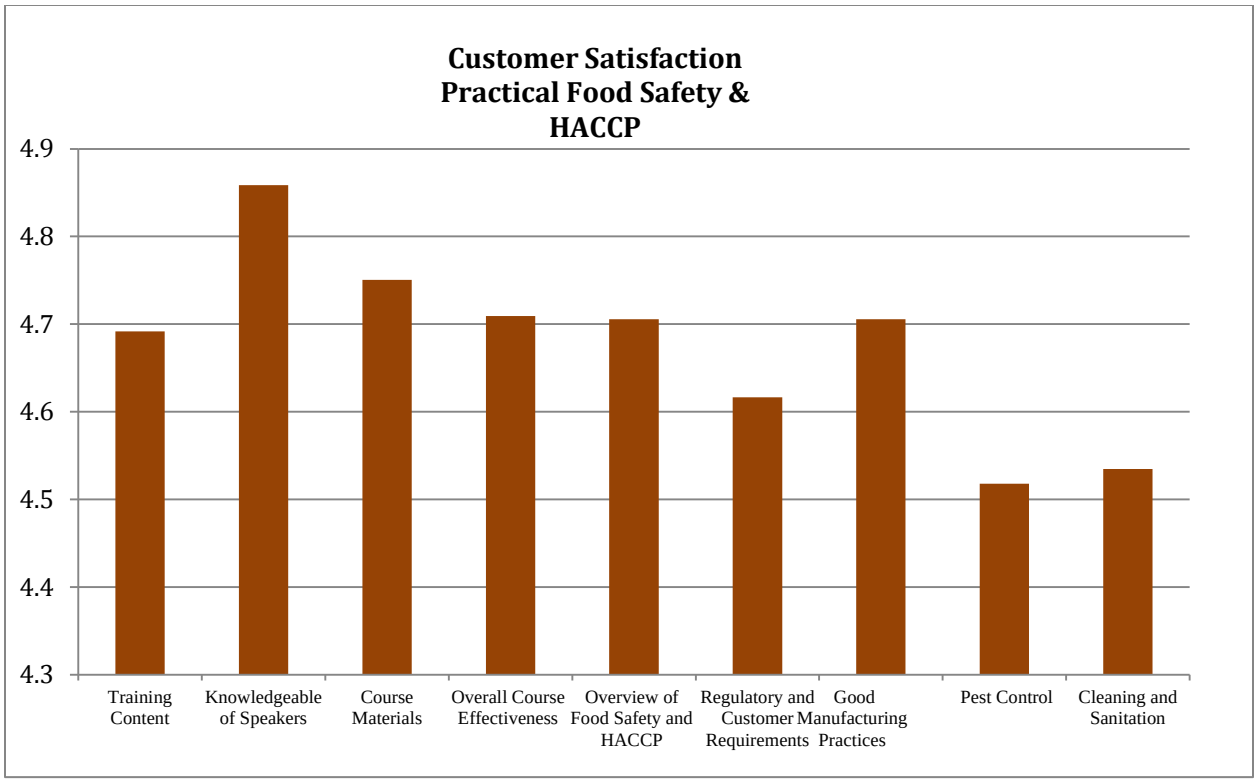
As stated in the previous section, over 300 employees from Idaho's specialty crop companies spent 5,500 hours in training activities learning about food safety prerequisite programs, HACCP (Hazard Analysis Critical Control Points) Implementation and Training, and GFSI Standards including new audit "schemes" or standards such as SQF, BRC, FSSC 22000 (ISO 22000), PrimusGFS, and others.

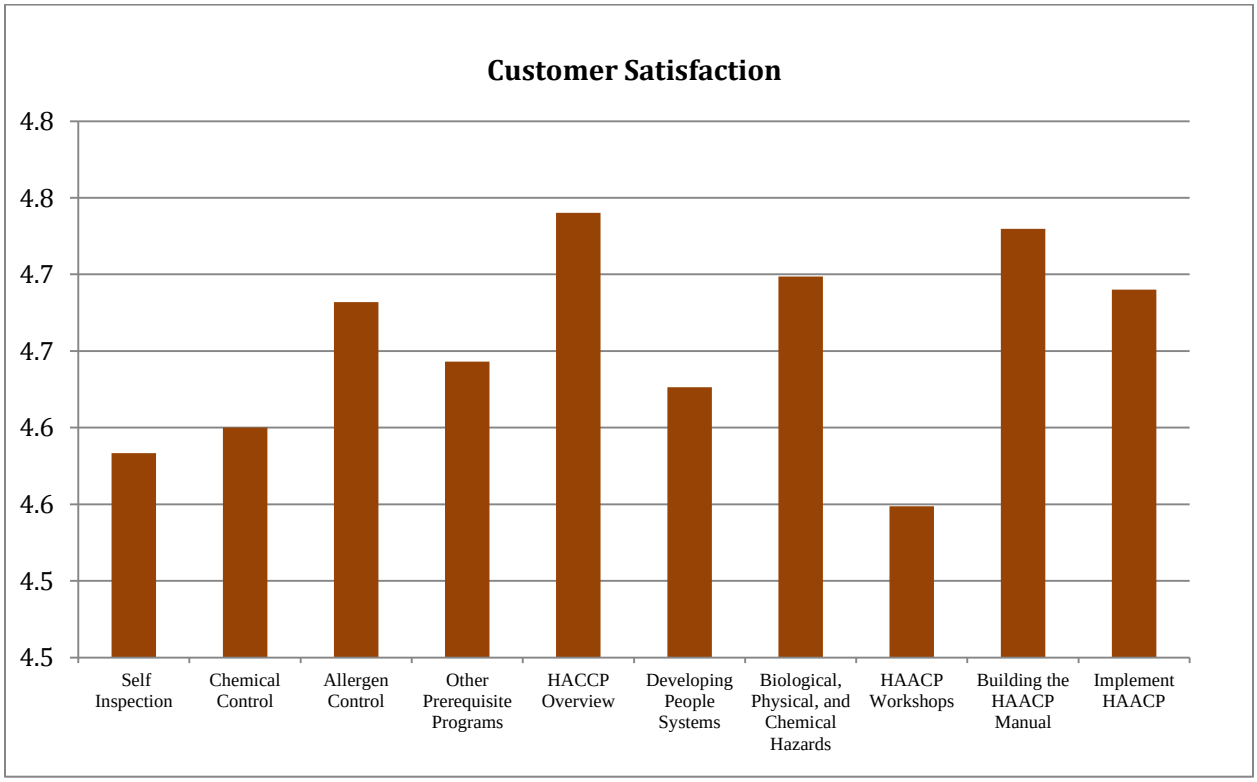
Goal in Application

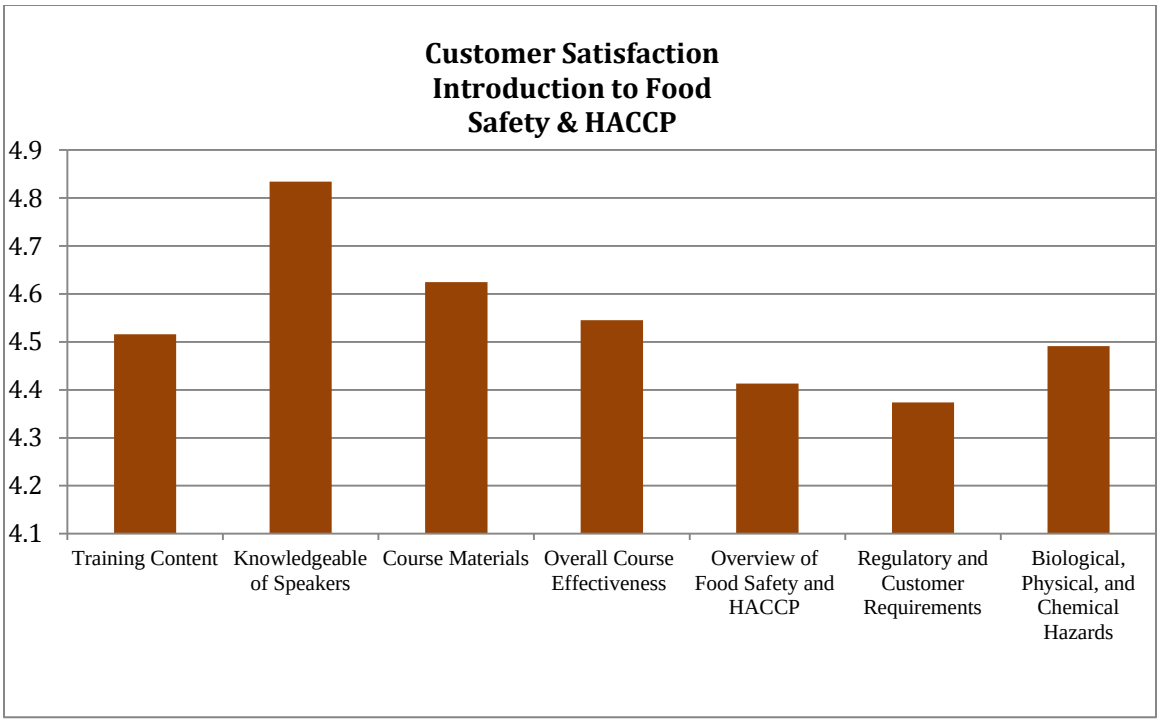
Through a survey, workshop attendees will evaluate the quality of the workshop content and its presenter immediately at the end of each workshop using TechHelp's Workshop Evaluation Form. The critique allows for numerical scoring and data tabulation based on participant feedback in the areas of workshop content, speaker quality, course materials, facilities, and overall satisfaction with the course.

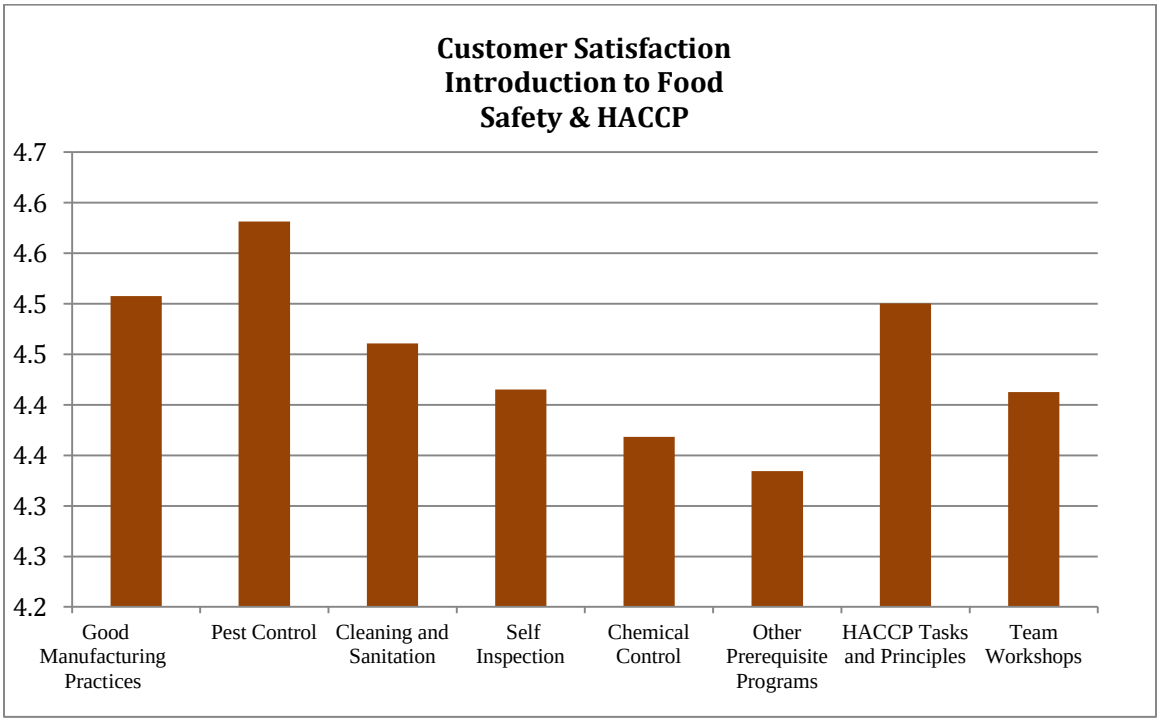
Progress or Accomplishment

Over 200 surveys were collected and tabulated. Overall, the courses were rated very effective with an average score of 4.6/5. Attendees were impressed with the knowledge level of the speakers giving an average score of 4.9/5.


Customer Satisfaction
Practical Food Safety & HACCP
4.9
4.8
4.7
4.6
4.5
4.4
4.3
Training Content
Knowledgeable of Speakers
Course Materials
Overall Course Effectiveness
Overview of Food Safety and HACCP
Regulatory and Customer Requirements
Good Manufacturing Practices
Pest Control
Cleaning and Sanitation


Customer Satisfaction
4.8
4.8
4.7
4.7
4.6
4.6
4.5
4.5
Self Inspection
Chemical Control
Allergen Control
Other Prerequisite Programs
HACCP Overview
Developing People Systems
Biological, Physical, and Chemical Hazards
HAACP Workshops
Building the HAACP Manual
Implement HAACP


Customer Satisfaction
Introduction to Food
Safety & HACCP
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
Training Content
Knowledgeable of Speakers
Course Materials
Overall Course Effectiveness
Overview of Food Safety and HACCP
Regulatory and Customer Requirements
Biological, Physical, and Chemical Hazards


Customer Satisfaction
Introduction to Food
Safety & HACCP
4.7
4.6
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4.5
4.5
4.4
4.4
4.3
4.3
4.2
Good Manufacturing Practices
Pest Control
Cleaning and Sanitation
Self Inspection
Chemical Control
Other Prerequisite Programs
HACCP Tasks and Principles
Team Workshops

Goal in Application

The second survey will be administered six months after completion of the workshop and/or on-site assessment in order to capture actual rather than projected impacts. Survey results will be reported in aggregate as industry sectors only; that is, individual company responses will be kept confidential and overall performance of each of the three key target groups will be reported.

Progress or Accomplishment

Limited data has been collected in this area because client projects and assessments submitted to be surveyed have not yet come up in the process. However, three clients who received an assessment and/or attended at least one workshop, in addition to previously receiving project assistance in the areas of food safety, HACCP, food safety audit preparation, ISO 22000 Compliance, and SQF gap assessments reported the following impacts:

Retained Sales	$5,150,000.00
Increased Sales	$100,000.00
Jobs Created	14
Jobs Retained	20
Cost Savings	$30,000.00
Investments	$27,000.00

The project was able to be completed using only $72,323.01 of the $80,032 budget. The remaining $7,708.99 will be reallocated to an existing applicant(s) on an as needed basis.

Beneficiaries

The main beneficiaries of this project were specialty crop companies in the areas of onions, apples, cherries, potatoes, peas, and lentils in Idaho and Eastern Oregon. Over 300 specialty crop employees were trained as a part of this project.

Lessons Learned

A few lessons were learned along the way of the project. One such lesson is regarding site assessments. All 30 site assessments were unable to be completed as projected, however the completed assessments were successful. Even though these assessments were at no cost to the clients, interest wasn't as high as predicted. Additional impact data from the assessments and workshops was not collected due to the departure (twice) of the workshop coordinator. TechHelp was successful in training many employees and in collecting their feedback on the workshops.

Future Plans & Activities

TechHelp intends to continue the project by utilizing unspent program income to subsidize activities that benefit specialty crop companies in Idaho. The FDA Food Safety Modernization Act (FSMA) signed into law by President Obama on January 4th, 2011 aims to ensure the U.S. food supply is safe by shifting the focus of federal regulators from responding to contamination to preventing it. TechHelp plans to offer a series of webinars and workshops in order to educate companies on the standards and to continue helping them improve food safety.

Starting in December, TechHelp is offering a series of PrimusGFS GAP Certification workshops in Ontario, Oregon; and in Idaho Falls and Moscow, Idaho. PrimusGFS is a food safety audit scheme which is approved by the Global Food Safety Initiative (GFSI) for the food safety certification of agricultural producers. It focuses on products of the agricultural sector designated for human consumption in their fresh or minimally processed state. PrimusGFS GAP certification establishes a series of requirements for managing production and handling of fruits and vegetables on the farm. Many retail customers such as Wal-Mart, Safeway, Publix, and Costco now require agricultural producers to be GAP-certified by a GFSI-compliant audit scheme, and will no longer accept the USDA GAP audit. This workshop will provide a simple, step by step guide on how to prepare an agricultural operation to successfully complete a PrimusGFS audit. Specialty crop companies can attend the one-day class at a reduced rate.

Additionally, TechHelp is planning a series of webinars on FMSA, Global Food Safety Initiative, Food Defense, and Food Safety. The webinar will focus on Food Safety regulations and will be presented by a nationally recognized law firm that specializing in such issues. Specialty crop companies will be offered reduced registration fees.

Assessments at client facilities will continue free of charge for specialty crop clients. Each client will be visited by a TechHelp Manufacturing or Food Specialist and will receive assessments in Food Safety & HACCP, E3 (Energy, Environment, Efficiency), or GFSI Standards.

Contact Person

Katie Quick
Boise State University
kquick@boisestate.edu
(208) 426-3858

Potato Virus Y Control in Idaho

Subrecipient
University of Idaho

Project Summary
Idaho is the largest producer of potatoes in the U.S., with about one-third of the national fall potato production and more than 30% of acreage in 2008. Further, more than a quarter of the U.S. potato processing capacity resides in Idaho. Potato industry contributes about $2.7B to the Idaho economy. In the past 3-5 years, *Potato virus Y* (PVY) emerged as the most serious threat to Idaho potato production, both directly through yield reduction, and indirectly affecting tuber quality and rendering tubers unmarketable. This PVY emergence is attributed to the high propensity of the virus to recombination, and spread of new, necrotic strains of PVY. These new PVY strains inducing external and internal damage of the tubers were found during an outbreak of PVY in potato production areas near Idaho Falls in 2007. In order to identify sources of these necrotic PVY strains, and devise a plan to control PVY in the State of Idaho, a survey of all seed potato lots that undergo winter testing in Idaho for incidence and prevalence of PVY strains in different potato cultivars was proposed. The data obtained through this project will lead to a comprehensive strategy to control PVY and eliminate necrotic PVY strains from the State of Idaho.

Project Approach
Two major objectives were pursued:

Analyze individual PVY positives from the leaf batches provided by ICIA and directly from the winter test location in Brawley, CA.

Collection of the leaf samples in California was based on visual readings of the mosaic and crinkling symptoms in both seasons, 2010-2011. However, during 2010-2011 testing seasons, the sampling, transportation, and PVY strain typing methodology, was significantly improved to make it applicable to large-scale screening. In 2009-10, Nolte's lab received leaf samples from 78 potato seed lots collected from the winter seed potato grow-out in Brawley, CA, and tested by ELISA at the ICIA Laboratory in Idaho Falls, ID. These were samples that had been determined to be PVY-positive, the PVY incidence varied from 1% to 14 % PVY. Nolte's group conducted extensive in-house ELISA re-testing of the leaf samples from potato lots with previously determined PVY positives. All plants determined to be positive for PVY were packed and shipped to the main campus for further typing to strain.

This logistical change allowed the number of analyzed samples to increase several-fold, and to achieve the initial goal of typing PVY positives in all Idaho seed potato lots coming to the winter grow-out program. In the next season, Karasev's group received leaf samples from more than 300 potato seed lots collected from the 2010-11 winter seed potato grow-out in Brawley, CA, and tested them by ELISA for general PVY and N- and O-type strains using strain-specific monoclonal antibodies 1F5 (Agdia), MAb2 (Agdia), and SASA-N (SASA). This ELISA analysis was conducted concomitantly with immunocapture-RT-PCR tests. All samples determined to be positive for PVY were subjected to RT-PCR tests for further typing to strain.

Type all PVY-positives to strain using RT-PCR technique.

In 2010, 735 samples were received from the winter grow-out tests, all were analyzed and the strain breakdown is presented in Table 1. A possible drop was noted in the proportion of non-recombinant PVY^{O} strain relative to other, recombinant strains, both PVY^{NTN} and $PVY^{N:O}$, compared to the 2009 data. Recombinant strains represented 68% of all PVY-positive samples from Idaho seed potato tested in the winter grow-out. Another interesting observation was tremendous clustering of recombinant PVY isolates, especially PVY^{NTN}, with specific cultivars and producers. In 2010, an attempt was made to alert producers with high proportion of PVY^{NTN} in their lots. This first attempt was successful – P. Nolte received a positive feedback from a producer who removed his seed from the system.

Table 1. Summary of the 2010 winter grow-out testing*.

735	Samples tested	100%
244	PVY-positive	33%
63	Typed PVY^{O}	26%
43	Typed $PVY^{N:O}$	18%
58	Typed PVY^{NTN}	24%
63	Typed $PVY^{NTN/N:O}$	26%

*Ten samples had mixed infection or inconclusive, and one had PVY^{NA-N}

As noted above, some improvements were made in sampling for the 2010-11 season, shortening time between sample collection and lab analysis. One other methodological change introduced for the 2011 season – was the use of the immunocapture-RT-PCR test for PVY typing. This reduced the number of samples subjected to the expensive RT-PCR analysis, and focused it only on PVY-positives.

Table 2. Batch I summary of the 2011 winter grow-out testing*.

382	Samples tested	100%
107	PVY-positive	28%
17	Typed PVY^{O}	16%
35	Typed $PVY^{N:O}$	33%
53	Typed PVY^{NTN}	50%

*Two samples had mixed infection or inconclusive

Thus, in 2011 two batches of samples were analyzed, one of 382 (Table 2) and another of 936 samples (Table 3), both received from Brawley, CA. All samples were subjected to an initial ELISA test, and of these only PVY-positives were further subjected to RT-PCR typing technique (Lorenzen et al., 2006). All PVY positive samples have been typed to strain, logged into a master file, and are being grouped according to the lot of origin, cultivar submitted for re-certification, and the generation number.

Table 3. Batch II summary of the 2011 winter grow-out testing*.

936	Samples tested	100%
425	PVY-positive	45%
66	Typed PVY^{O}	16%
137	Typed $PVY^{N:O}$	32%
48	Typed PVY^{NTN}	11%
157	Typed $PVY^{O/N:O}$	37%

*Thirteen samples had mixed infection or inconclusive, and four had PVY^{NA-N}

For the 2011 season, a further drop in the proportion of non-recombinant PVY^{O} strain relative to other, recombinant strains, both PVY^{NTN} and $PVY^{N:O}$, was noted comparing to the 2009 and 2010 data. Recombinant strains represented 80% of all PVY-positive samples from Idaho seed potato tested in the winter grow-out. For the third year in a row, the observation on tremendous clustering of recombinant PVY isolates, especially PVY^{NTN}, with specific cultivars and producers was confirmed. In 2011, experiments with alerting producers having high proportion of PVY^{NTN} in their lots were continued. These attempts were also successful – P. Nolte received a positive feedback from two producers who removed their seed from the system. Tests of select isolates from the winter grow-out in biological experiments on tobacco and potato indicators are in progress. These experiments are still on-going and will continue with the renewed funding of this project through the 2011 Specialty Crop Block Grant Program.

Goals and Outcomes Achieved

The entire potato seed crop submitted for the Idaho winter grow-out test, over 300 seed lots in total, was subjected to testing for the PVY presence, and subsequent typing of the PVY-positives to type. The project sought to determine the incidence of the recombinant PVY strains in Idaho potato, and this objective was achieved.

The longer-term objective of the project was to determine the dynamic of the recombinant PVY incidence, e.g. if and how the proportion of different recombinant strains may be changing over time. Based on this 2-year study a shift was noted from a non-recombinant O type to a recombinant N:O type. The proportion of the most damaging, tuber necrotic strain PVY^{NTN} was found unchanged between 2009-2011, at about the 20% mark, which is good news for the industry.

The proposal was geared to the coverage of the entire seed potato crop, and was successful in analyzing the lots submitted for the winter testing, i.e. the majority of the Idaho potato seed produced in 2010 and 2011.

Before the start of this project only anecdotal or extremely limited data existed on the typing of PVY strains circulating in Idaho seed potato. This project created a first comprehensive data set on PVY strain composition, their geographical and cultivar distribution, and initial dynamic changes from year-to-year in Idaho seed potato. This information was crucial in formulating a follow-up proposal to eradicate the recombinant, tuber damaging PVY strains from the Idaho seed potato production system, which was funded for the next 2-year cycle through SCBG.

Beneficiaries

The PVY survey advisory group met twice during the project period, in January 2010 and in June 2011, with both co-PIs presenting the progress of the study. This group is composed of four potato industry representatives, familiar with the seed potato production and with the PVY problem. Members of the advisory group are Mr. Clen Atchley (Ashton, ID), Mr. Jeffrey Bragg (Idaho Falls, ID), Mr. Allan French (Nampa, ID), and Mr. Ritchey Toevs (American Falls, ID). Two of the members represent independent potato seed producers, and two others represent large private companies involved in potato production and processing (Potandon and Simplot).

The change in the proportion (68% to 80% in just 2 years) and breakdown of the recombinant PVY strains (with rising share of $PVY^{N:O}$) were communicated to the seed potato growers at the advisory group meetings, at the Idaho Potato Commission meetings in March 2010, November 2010, and February 2011, and at the annual Idaho Potato Conference in January 2010.

The advisory group recommended to present major conclusions of the study at the Idaho Potato Seed Growers Seminar in January 2012, which is in the process of preparation.

Lessons Learned

The quality of samples coming to Moscow, Idaho was a concern in the 2010 season. Since most of the samples were initially collected in California, shipped to Idaho Falls, and only after passing through two labs in Idaho Falls, were shipped to the main campus, some of them rotted away. A direct shipment from Brawley to Moscow was tried by P. Nolte in December 2010, and was found in a much better shape. This change was instituted in February 2011 and resulted in significant improvements in the typing methodology, and the overall speed and reliability of the assay.

Since winter 2010-11, only direct shipments from Brawley to Moscow were used, these were packed and forwarded by P. Nolte and his group during visits of the winter grow-out plots in February-March. No major problems were experienced in 2011, the project proceeded on schedule, and all objectives were achieved.

Contact Person

Alexander V. Karasev
University of Idaho
akarasev@uidaho.edu
(208) 885-2350 (office)

Television Promotion of Idaho Specialty Crops

Subrecipient
Idaho State Department of Agriculture Idaho Preferred Program

Project Summary
The purpose of this project was to increase consumer awareness and demand for Idaho fruits, vegetables, wine, herbs and nursery products through statewide television advertising. Consumer market research conducted in December 2008 found that 88% of consumers are buying the same amount or more local products and 77% of consumers report that supporting local farmers and economies as their primary reason for buying local products. It is critical that the Specialty Crop industry take advantage of this current consumer trend by increasing the awareness of the fruits, vegetables, wines and nursery products grown in Idaho during peak production periods. Television advertising is the most effective means of reaching consumers with this message as fresh fruits, vegetables and nursery products are very visually appealing and best represented with video rather than audio or print. When additional funds became available in January 2012, the television campaign was supplemented with a summer campaign that included radio and on-line advertising featuring seasonal fruits and vegetables.

Project Approach
This grant funded five weeks of television advertising statewide - promoting Idaho fruits, vegetables and nursery products exclusively. This schedule was supplemented by four additional weeks of television funded by other state and grant funds for a total of nine weeks of television in 2011. Ads were placed in April and May to promote nursery products, and again in September and October to promote specialty crop foods. To keep the advertising fresh, a new specialty crop ad was created in 2011 featuring local growers and the wide variety of specialty crops produced in Idaho. With supplemental funding awarded in January 2012, the campaign was expanded to include three weeks of spot radio, six weeks of live read radio, 4 weeks of Facebook ads, 5 weeks of Internet banner ads and five weeks of Google adwords that were placed in June through August of 2012. These ads were specific to specialty crops that were in season at the time ads were running.

In order to evaluate the effectiveness of advertising, consumer market research was an integral part of this grant. In October 2010, the University of Idaho Social Science Research Unit was hired to collect the data via a phone survey of 600 Idaho residents to evaluate the awareness of Specialty Crop Grant funded television advertising. Results, detailed below, assessed the effectiveness of past campaigns and also serve as a baseline for this Specialty Crop grant-funded campaign that aired in 2011.

Goals and Outcomes Achieved
Goal 1: 50% of consumers will say that they have seen the specialty crop television campaign.

Outcomes achieved:

- 66% of consumers say they have seen Idaho Preferred advertising promoting specialty crops
- 76% report having seen the ads in the media (as opposed to grocery store, labeling, etc)
- 57% report having seen the ad on television specifically

- 39% report seeing fruits and vegetables in the ad
- 8% report seeing wine in the ad
- 4% report seeing nursery products in the ad

Goal 2: 25% of consumers will report buying more fresh local produce and nursery items

Outcomes achieved:

- 91% of consumers report they are buying more or the same amount of local products (all products)
- 83% of those buying more say they are buying more local fruits and vegetables
- 11% say they are buying more local nursery products
- 7% say they are buying more local wines

Goal 3: In 2008, 77% reported they were buying more local products to support the local economy. Goal was to track trends to see if this is still the driving force behind local purchases – or if other factors are affecting buying decisions

- 75% report buying more local products to support the local economy
- 39% report buying more local products because they are fresher
- 30% report buying more local products because they are of higher quality
- 29% report buying more local products because they are healthier

Live Read Radio

Live read radio was initially planned at 6 weeks, but was reduced to 5 weeks to allow an integrated 5 week campaign with Live Read radio and on-line advertising. As a result live read was reduced one week and Facebook ads increased one week in addition to banner ads and Google adwords so that all mediums worked together synergistically during this period. The live read ads aired on 18 stations across the state, 5 spots per week for a total of 90 live read mentions per week and 450 spots throughout the 5 week campaign. Products featured in the live read ads included cherries, flowers, peaches, sweet corn, and melons.

Spot Radio

Spot radio also ran for five weeks during the summer, but only three weeks were paid for from this grant. Spot radio ads are pre-recorded 30 second spots that ran statewide on 20 stations in August and September. Paid gross ratings points of 35-37 were achieved across all weeks. However, most radio stations provide no-cost matching spots achieving a total of approximately 60 GRPs.

Facebook

The five-week Facebook campaign achieved total impressions of 2,772,377 and 704 click throughs to the Idaho Preferred website for a cost of only $1125. This impression level from Facebook is quite high. Obviously all impressions did not directly result in clicks but the ads built awareness of the seasonal availability of melons, sweet corn, cherries, flowers and peaches and may result in post-impression activity that is not trackable through Facebook. This part of the integrated radio and on-line campaign was cost-effective and reached a large number of the target audience.

On-line Banner Ads

To strengthen the radio/Facebook campaign, online banner ads were placed on the top-rated website in Boise (KTVB.com), the top news channel in the market. Animated banner ads appeared for five weeks from May through September featuring flowers, cherries, peaches, sweet corn and melons. The campaign resulted in nearly 745,000 impressions with over 650 click-throughs for a cost of about $3,000.

Google Adwords

This was the first time that Google has been added to the online campaign to promote Idaho specialty crops. Performance was moderate. The five-week campaign earned about 639,000 impressions and 785 clicks for a cost of about $1,000. The Click-Through Rate (CTR) of 0.40% is considered successful in this type of advertising. However, this Google campaign resulted in an average of only 0.12%, so will probably not be included in future online advertising plans.

Beneficiaries

Idaho Preferred® currently includes 274 participants, of which 109 (40%) are specialty crop producers, processors, and supporting organizations. All of these producers benefit from the increased awareness and demand for local products.

Lessons Learned

Television advertising continues to be an effective medium for reaching target consumers with messages about local specialty crops as confirmed by market research findings. Research showing that supporting the local economy was the primary reason for buying local led to creation of new ad content that included the local support message. Additionally, online advertising, when combined with a radio campaign, increases traffic to a website where consumers can find information about local specialty crop producers and where their products can be found.

Contact Person

Leah M. Clark, Idaho Preferred®
Idaho State Department of Agriculture
Leah.Clark@agri.idaho.gov
(208) 332-8684

Additional Information

The Specialty Crop ad created and aired as a result of this grant can be viewed at www.idahopreferred.com. Note that there are two commercials on the site, one specialty crop and one that includes non-specialty crop foods. Only the 100% specialty crop ad was created and aired with this grant.